MODERN
Machine Shop

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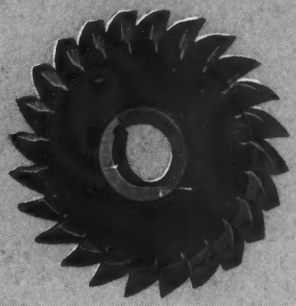

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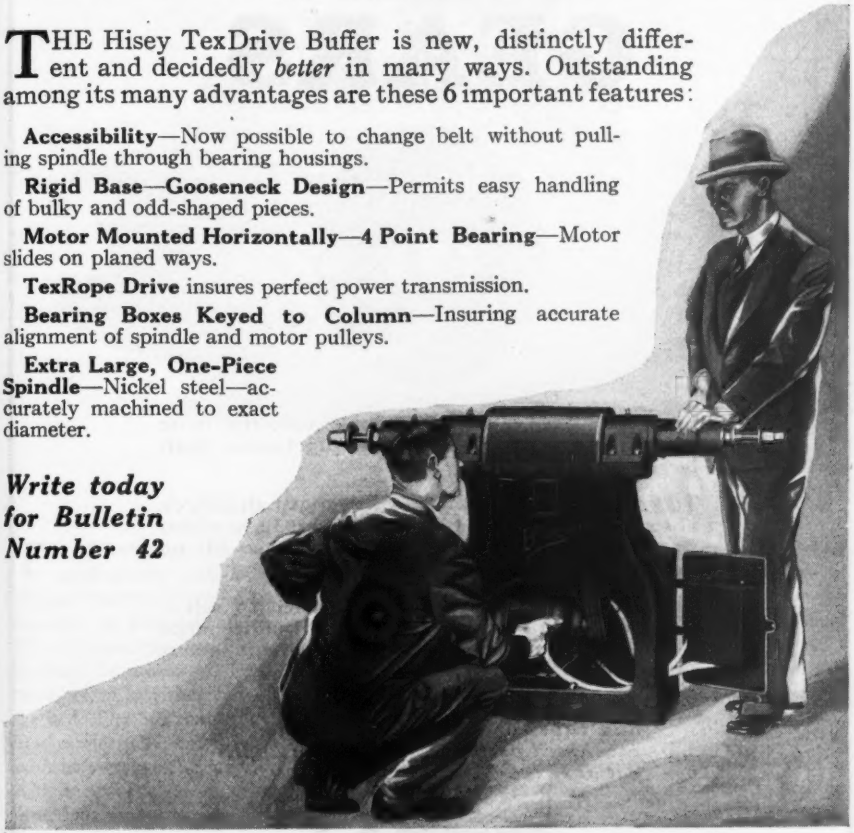

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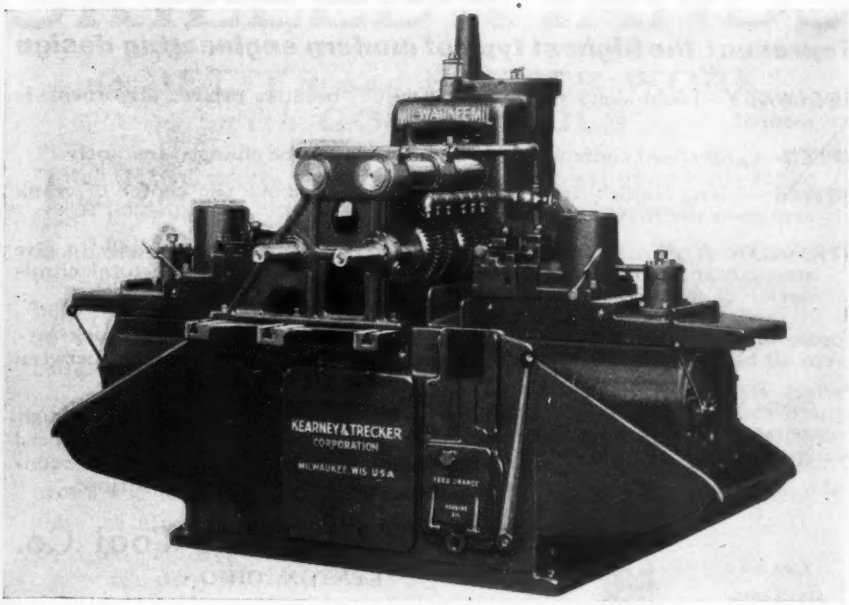

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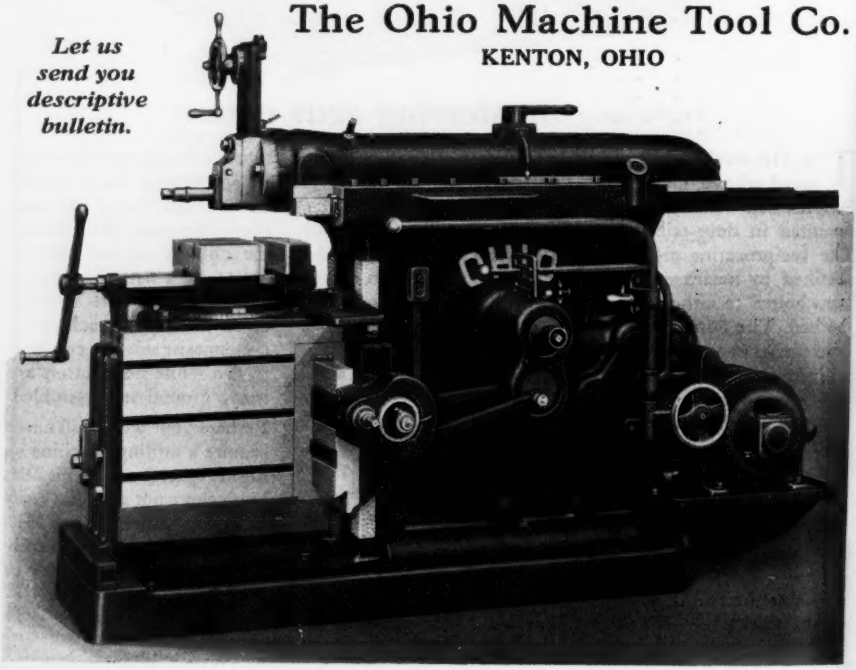

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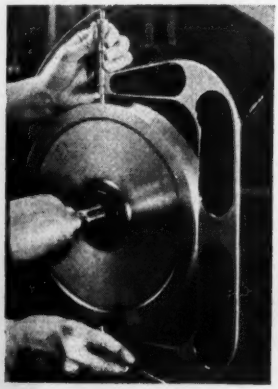

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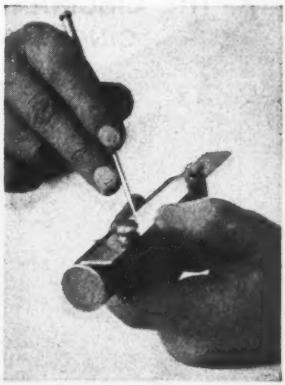

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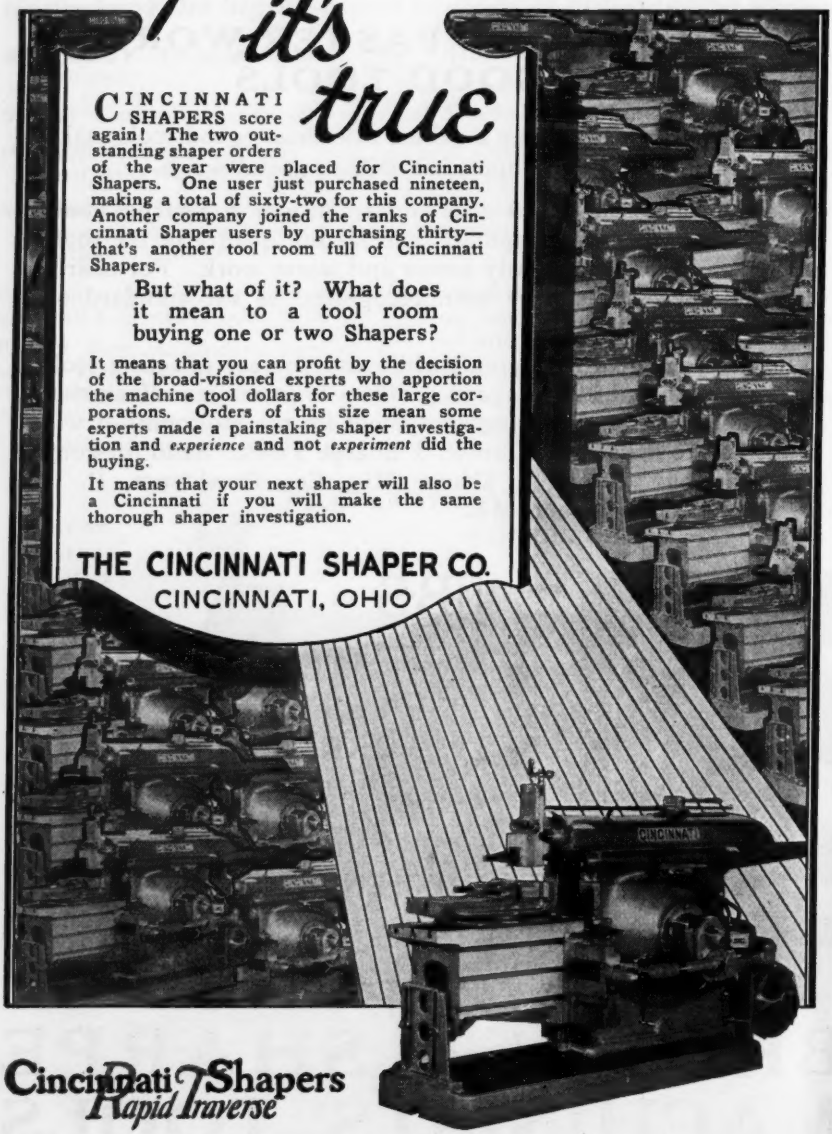

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MODERN Machine Shop

A MAGAZINE FOR MACHINE SHOP EXECUTIVES

Published monthly at 128 Opera Place, Cincinnati, Ohio

DON G. GARDNER, *Publisher and Gen. Mgr.* — HOWARD CAMPBELL, *Editor.*

Vol. 1 MAY, 1929 No. 12

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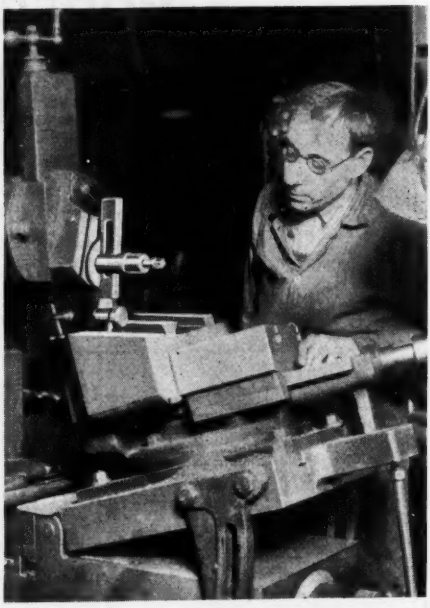

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MODERN
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MAY, 1929

CINCINNATI, OHIO VOL. 1, NO. 12

The Making of Molds for Rubber Tires

By HOWARD CAMPBELL

A VERY important part of the equipment that is used in the manufacture of rubber tires is the mold in which the tire attains its final shape and form. In this mold, also, it receives the final treatment that transforms it from a soft mass of layers of cotton fabric and raw rubber to the finished product. The making of tire molds was originally considered a necessary part of the operation of a rubber tire factory, but the fact that the working of metal is so entirely foreign to the manufacture of rubber products, coupled with the continually-increasing demand for molds, has led to the development of a number of machine shops that are devoted entirely to the production of molds.

One of the best-known of the plants engaged in this work is the Franz Foundry & Machine Company, located at Akron, Ohio, the "rubber city." This company not only makes molds for the tire manufacturers in and around Akron, but also maintains a shop at Los Angeles, where molds are made for the tire manufacturers who have plants on the Pacific coast.

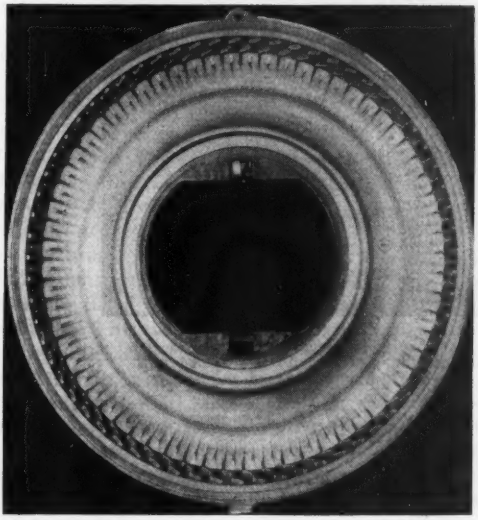


Fig. 1—Finished Tire Mold.

Molds, as a commercial product, are made to specifications furnished by the tire manufacturer. Each mold consists of two halves, with two rings which become a part of the mold when in operation. Each half is a separate casting of either steel or iron, the kind of material used depending upon whether or not the mold is to

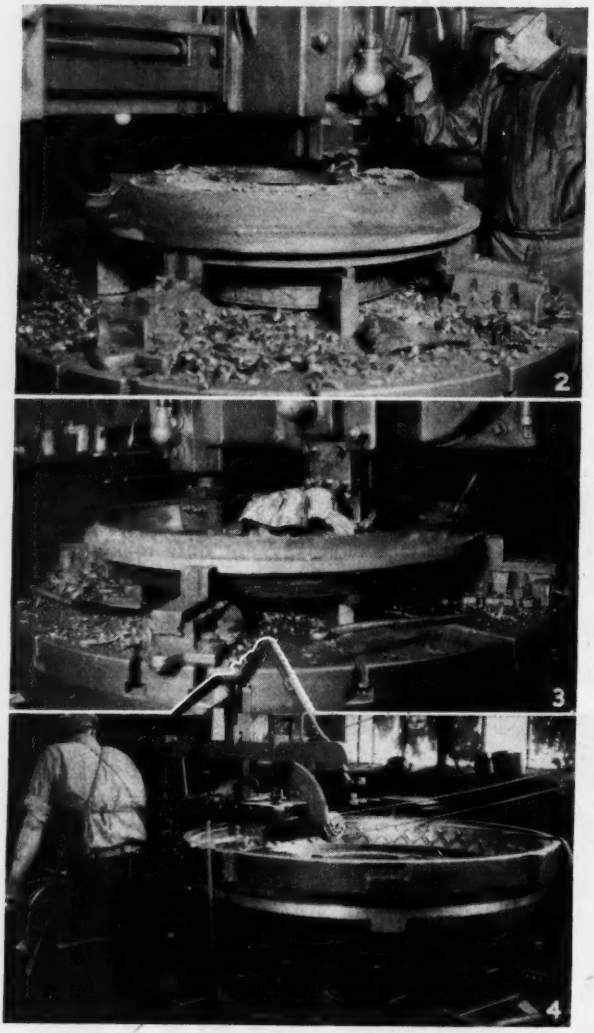
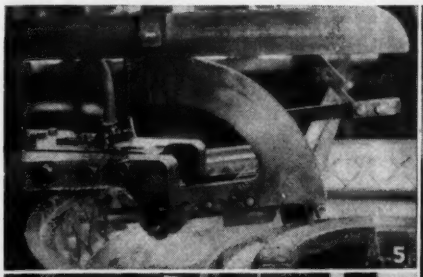


Fig. 2—Facing off the back of a steel casting for a tire mold. Fig. 3—The interior of the mold is finished with a form tool. Fig. 4—Machining the tread design in a tire mold.

be used for a long "run." Some of the molds are cast with steam-jackets enclosing the molds proper, so that the necessary heat can be supplied by steam, but such molds are intended for use in making tire repairs and are not used in manufacturing.

The first operation on a tire mold casting is that of facing the back of the casting, which is done on a boring mill as shown in Fig. 2. The piece shown is of cast steel. After the finish cut has been taken, leaving a smooth surface upon which to locate the casting for subsequent operations, the casting is turned over and set on parallels on the machine table, where it is clamped. The front, or contact side, is now faced, turned and formed according to the dimensions and specifications on the drawing. The final finishing and sizing of the mold is done with a form tool, shown in operation in Fig. 3. This tool is ground to a templet that has been cut out of sheet steel, laid out and ground to a perfect replica of the intended contour of the tire. When finished, the tool will not vary more than .003 inch from the size and contour indicated on the drawing. At the time this picture was taken, the tool was peeling off a shaving several inches wide and of about the thickness of paper.

The most interesting operation in the making of a tire mold is the engraving of the tread-design, or "skid."



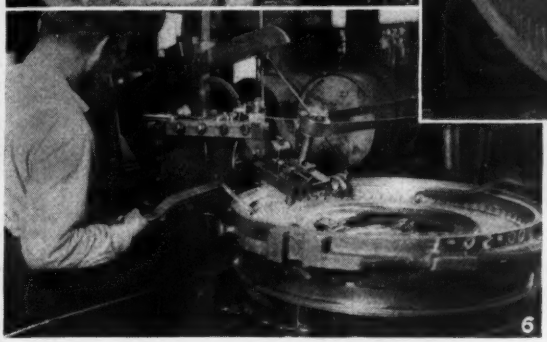


Fig. 5—A close-up view of the "skidding" tool in operation. Fig. 6—Tread designs in molds for small tires are cut on this machine. Fig. 7—Rough edges and corners are smoothed up with a small tool that is driven by a flexible shaft.

The machines used for this work are of special design, and a mechanic on this operation becomes adept only after considerable experience. The design of the tread is laid out and a templet is cut out of sheet steel, this templet serving as a "follower" guide for the tool on the machine, the machine operating as a pantagraph.

In operating the machine, Fig. 4, the mechanic manipulates two levers, one lever controlling the movement of the tool in a direction parallel with the bed of the machine, the other lever controlling mechanism which imparts, within certain limits, a radial movement to the table. The tool used is similar to a profiling tool in design, and is operated in much the same manner. The tool is fed into the metal to the proper depth, then the mechanic feeds it back and forth in one direction by the operation of a lever which also controls the movement of the guide in the pattern. Stock is fed to the tool by the movement of the lever which controls the radial movement of the table, the pattern swinging with the table. An experienced operator operates his machine by following the movement of the follower in the guide and pays no attention whatever to the movement of the tool, excepting, perhaps, to note the condition of it as he indexes the table for the next cut. A dividing head, which controls the rotary motion of the table, makes it possible to obtain the spacing required by the design of the tread. A close-up view of the tool in operation is shown in Fig. 5.

Treads on molds for tires of the smaller sizes are cut on smaller machines, one of which is shown in Fig. 6. On this type of machine the tool is operated by means of a lever which is attached directly to it, the radial movement of the table being controlled by a pattern and "guide," similar to those used on larger machines.

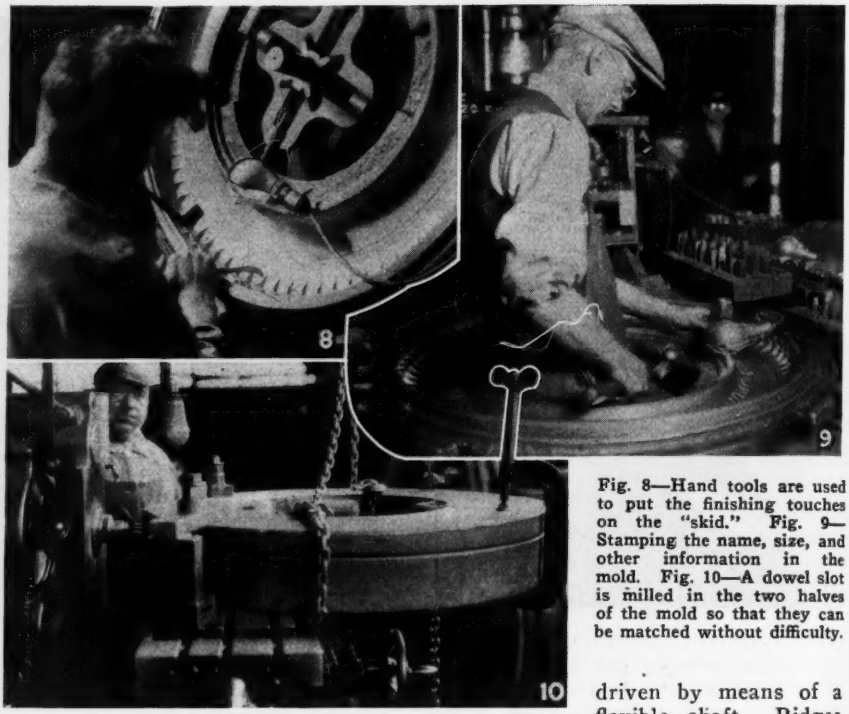


Fig. 8—Hand tools are used to put the finishing touches on the "skid." Fig. 9—Stamping the name, size, and other information in the mold. Fig. 10—A dowel slot is milled in the two halves of the mold so that they can be matched without difficulty.

The tread-engraving or "skidding" tool leaves the edges and surface of the metal in a rough state, necessitating a series of hand-dressing operations to complete the job. All of this work is done in a separate department, which is equipped so that the work can be handled to advantage. Operations on each mold are facilitated by use of a "cat-head," which is anchored by means of four pointed screws, in the hole in the center of the mold and is then slipped over a stud that projects from a rack, as shown in Fig. 7. This arrangement makes it possible to rotate the mold so that every part of the design will be accessible.

The rough edges and corners of the skid design are machined off with a small, conical tool, Fig. 7, that is driven by means of a flexible shaft. Ridges left by the skidding tool and corners into which the tool could not enter are chipped out with a light pneumatic hammer, using chisels that have been made especially for this purpose. The final operation — smoothing and polishing—is done with hand tools as shown in Fig. 8. This operation completes the work on the tread design.

The mold now goes to a bench where the firm name, tire size, and other information is stamped into the tread with steel stamps, in reverse, so that the lettering will be moulded into the wall of the finished tire. This operation, Fig. 9, is done by hand

The two halves of the mold are now clamped together so that the two halves of the tread design will match, and the mold is clamped to the table

(Continued on page 26)

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Flat Surface Grinding

By DONALD A. CLARK*

THE finishing of flat surfaces on metal parts by holding the parts against an abrasive wheel has been a common operation since the grinding wheel was first developed. The difficulty encountered in keeping a grinding wheel in such condition that a flat surface could be ground with any degree of accuracy forced the development of a disc to which a sheet of abrasive-covered cloth or paper could be attached, and the disc-grinding tool took its place as an economical method of finishing surfaces which were required to be flat, but which were not required to bear a definite relation to any other surface or dimension. Lack of a given dimension to work to allows for the removal of a minimum amount of stock and thus provides for quick processing.

Fig. 1—"Semi-lapping" Nash bearing caps after milling. A 75 per cent bearing is obtained by this method.

The advantages of flat surface grinding by the use of an abrasive disc wheel, such as economy, ease of operation, and simplicity, have led to the inclusion of a disc grinding operation as supplementary to milling or other finishing methods, and more recently fixtures and attachments have been devised which make it possible to grind various surfaces at a predetermined and accurate angle with other surfaces. The semi-lapping operation is intended as a finishing operation only, where a smooth surface is desired, thus making it possible to operate the more costly and more complicated machines at higher rates of speed.

The surface left by a milling cutter when operating under heavy feed is, of course, much rougher than when a finer feed is used, but the time required to produce a smooth surface by the use of a disc wheel is much less than the time that would be required to produce a correspondingly smooth surface by the milling method. Thus a saving is made in production time, the labor cost is reduced due to the fact that an unskilled operator can be used on the grinder, and the machine burden is lower.

The illustration Fig. 1 shows an operator disc grinding or "semi-lapping" the contact surfaces of main bearing caps at the plant of the Nash Motor Company, Racine, Wisconsin. The bulk of the stock was removed in a previous milling operation, from .002 to .003 inch of stock being left to be removed by the semi-lapping method. A fine-grain disc is used, producing a sur-

* Photographs and data courtesy Gardner Machine Co.

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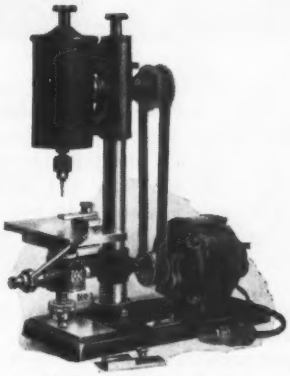
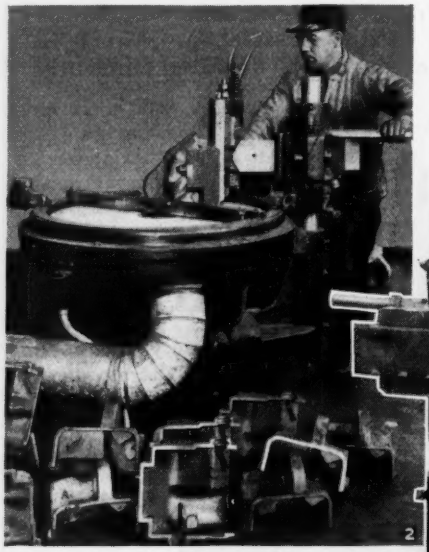


Machine with hood in place, and with square table.

ADOLPH MUEHLMATT

FIFTH AND ELM STREETS, S. E. CINCINNATI, OHIO

face which is practically polished and with approximately 75 per cent bearing contact. The production rate is six pieces per minute. This operation is also included in the processing of connecting rods and caps and other similar parts at this plant.



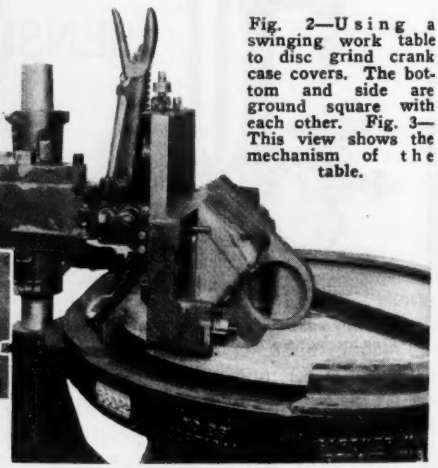


Fig. 2—Using a swinging work table to disc grind crank case covers. The bottom and side are ground square with each other. Fig. 3—This view shows the mechanism of the table.

The Gardner Machine Company has recently developed a swinging work table which makes it possible to grind a flat surface in definite relation to other surfaces on the piece. The work table is shown in use in Fig. 2, where an operator is seen grinding a cast iron crank case cover for a 1½ h. p. gasoline engine. The bottom surface of the piece is first ground by hand on the same machine, removing approximately $\frac{1}{16}$-inch of stock, then the piece is clamped in the fixture on the swinging work table and the side is ground square with the bottom, within .005 inch. The production rate is twenty-five pieces per hour complete, which includes both sides. A close-up view of the hand-operated table is shown in Fig. 3, giving an opportunity for a closer inspection of the mechanism.

A particularly interesting method of holding work is illustrated in Figs. 4 and 5, which show a Gardner horizontal grinder equipped with a special fixture for grinding reservoirs for shock absorbers. The fixture consists of a steel loading table, a steel disc with six U-shaped openings, and six arms located directly over the six openings. The disc and arms rotate when in operation. Each arm carries a magnet, which is located over the opening in the disc. As the disc rotates past the operator, he places a piece in each opening so that it will be carried along.

Just before the piece is carried onto the abrasive disc, however, the arm lowers the magnet so that it contacts with the piece and lifts it off the table. As the piece approaches grinding position, the arm lowers it onto the abrasive disc and presses it down, holding it against the abrasive until just before it passes off the abrasive disc on the opposite side. Here the arm raises again, lifting the piece clear of the wheel and holding it until it is scraped off the magnet by

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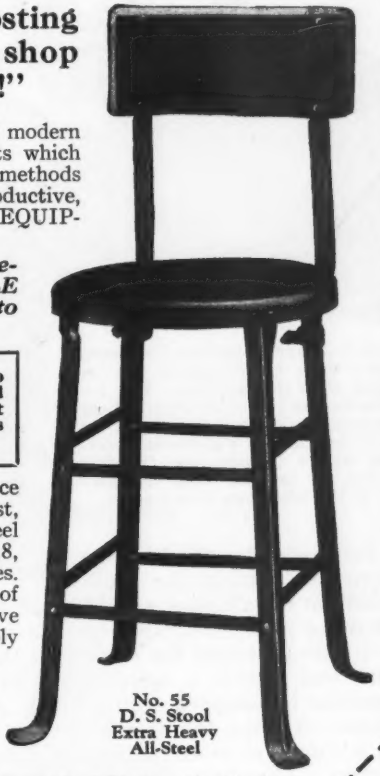

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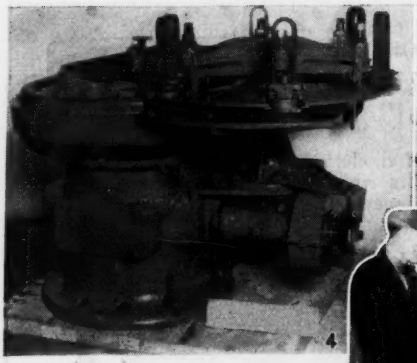

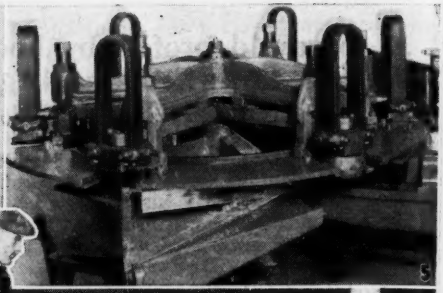

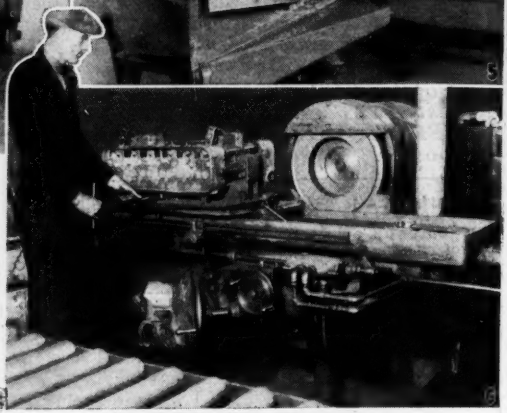

Fig. 4—Magnets pick up the pieces, place them on the wheel, and remove them after grinding. Fig. 5—The finished pieces are swept off the magnets by the bar underneath the revolving table. Fig. 6—An indexing fixture provides for changing pieces on one side while the piece on the other side is in process.

a bar that is provided for the purpose. Setting the work down on the abrasive wheel instead of allowing it to be scraped on and off the edge preserves the surface of the disc and secures a better job. The machine is equipped with a 7½ h. p. motor to drive the spindle and a 1 h. p. motor to drive the fixture. The fixture rotates at a rate of 3 r. p. m., producing 18 pieces per minute.

The machine described in the preceding paragraphs are of the horizontal type, but fixtures to aid in the production of more and better work can be applied to the vertical type disc grinder to even better advantage. The application of an indexing fixture to a Gardner No. 1 Hydraulic Surface Grinding Machine is shown in Fig. 6, where an operator can be seen loading the fixture with Nash cylinder heads. In this operation, $\frac{1}{16}$ inch of stock is removed from a ¼-inch bead around the top side of the head and the surface is held within .004 to .006 inch of a perfect flat. The fixture is designed so that the operator can be replacing one piece while the other is in process. The production rate is thirty pieces per hour.

Both speed and accuracy are obtained by the use of the revolving drum, shown in Fig. 7, applied to a Gardner semi-automatic disc grinder. The large volume is possible because of the fact that the machine feeds the work to the wheel automatically, leaving the operator free to load the fixtures as the drum revolves, and the accuracy is obtained both as a result of the extra rugged design of the machine and because of the careful provision that has been made for the proper truing of the grinding wheel.

The machine is shown set up to grind front and rear spring hangers for an automobile manufacturer. Eight quick-acting clamping fixtures are used, mounted on the octagonal drum. As the pieces are brought to grinding position by the revolving

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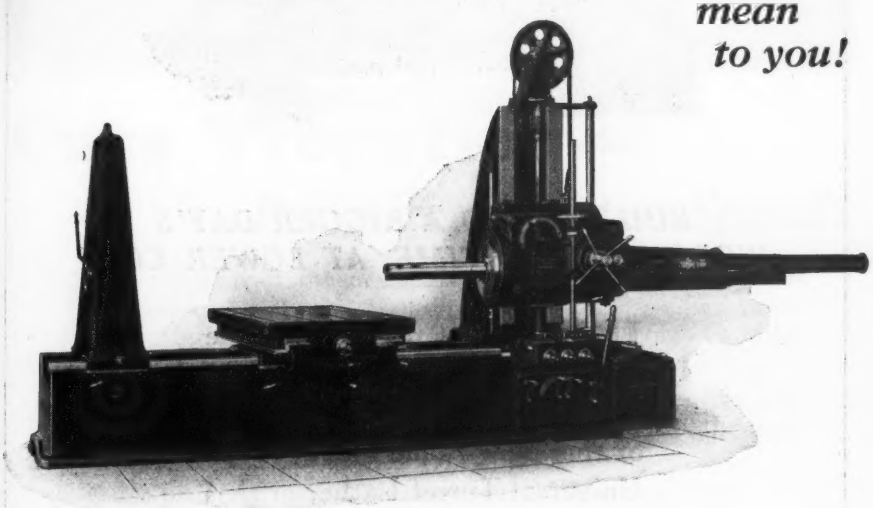

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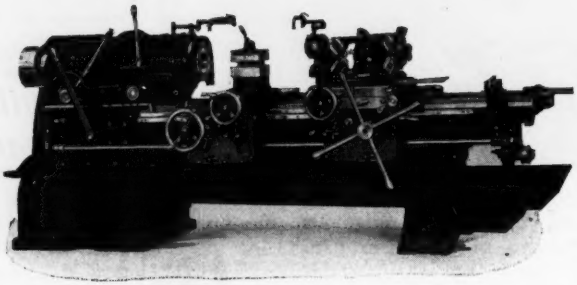

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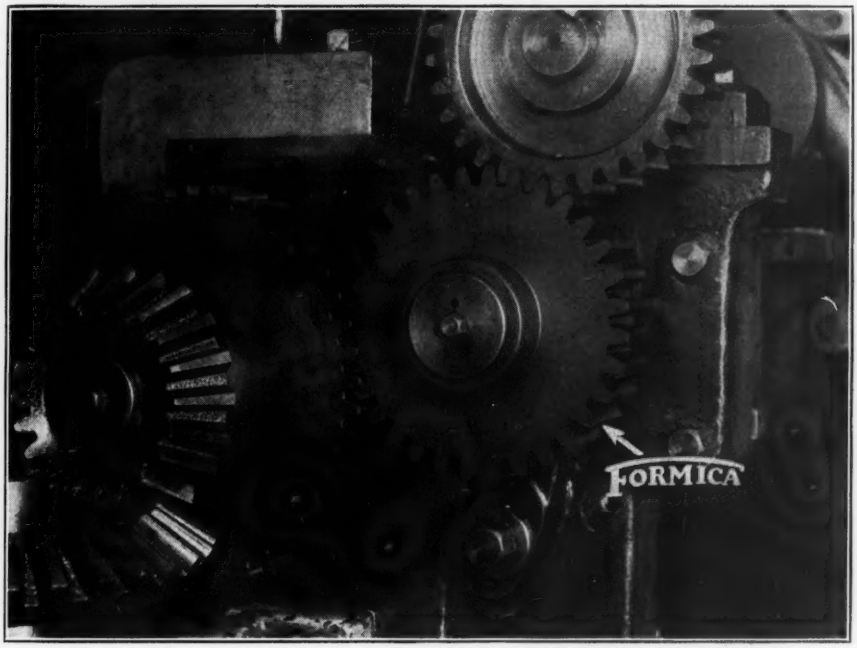

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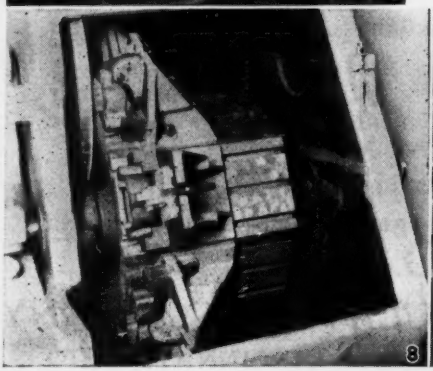
drum, the abrasive wheel automatically advances toward them, holds the grinding position for a given length of time, and then withdraws, this action being repeated as each piece advances toward the edge of the wheel. The wheel removes approximately 1/32 inch of stock from an area that may range from 2½ to 4 square inches, and is grinding 700 of these pieces per hour. The close-up view of the drum and fixtures, Fig. 8, shows details of the mechanism.

The same type of machine is shown in Fig. 9, equipped with a set of special fixtures for grinding cast iron shock absorber bodies. As each piece is placed in the fixture, it is automatically locked in position by a clamp that is operated by a cam and cam lever. The cam, which is stationary, is cut away around the lower part so that as the pieces are carried past the wheel by the revolving drum, the cam levers are released by the low spot and the clamps are loosened, allowing the pieces to fall out into a receptacle at the rear of the machine. After new pieces have been put in and the drum carries the work to grinding position, the levers ride up on the high spot on the cam, clamping the pieces in the fixtures. Approximately $\frac{1}{16}$-inch of stock is removed from each piece and they are ground at the rate of 10 to 12 pieces per minute.

An automatic disc grinder of a somewhat different type is illustrated in Fig. 10. This machine is a Gardner No. 4 special, equipped with a special fixture for grinding the asbestos composition lining on internal expanding brake shoes. The arc of the shoe is ground after the lining has been applied in order to eliminate inac-



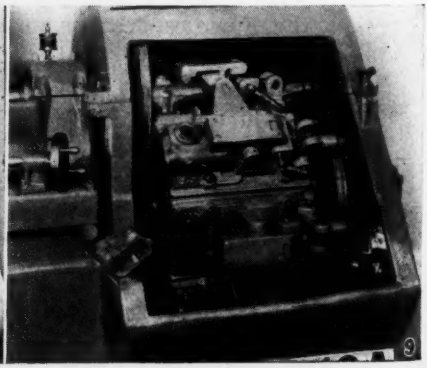


Fig. 7—A semi-automatic grinder, equipped with a revolving drum and eight fixtures, grinds 700 spring hangers per hour. Fig. 8—This view shows the design of the fixtures. Fig. 9—As this drum revolves, the pieces are clamped or released by the cam mechanism at the end of the drum. The work is automatically discharged at the rear of the machine after grinding.

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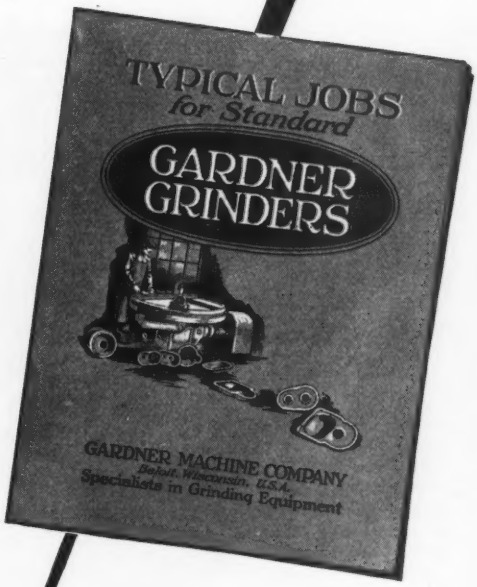

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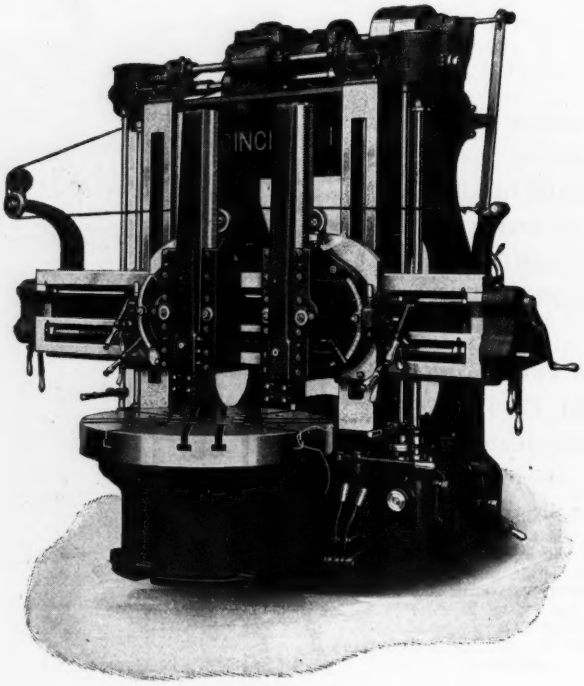

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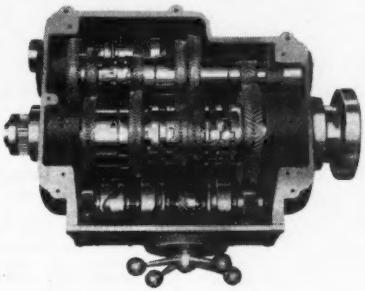

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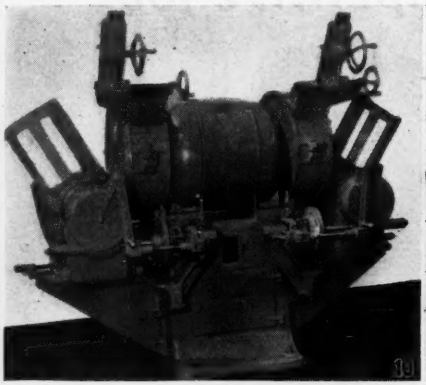
curacies and to produce brake shoes of uniform measurements.

The machine is equipped with two abrasive wheels, a fixture in which the shoes are clamped during the grinding operation being supplied for each wheel. The operator places the shoes in a chute from which they drop into the fixture by gravity. There they are mechanically clamped and revolved past the wheel, after which the clamps release, permitting the shoes to drop out into a container or onto a conveyor. Each wheel is totally enclosed and is supplied with its own dresser, and although both wheels are driven by one motor, they can be disconnected and operated separately if desired. In several cases where these machines are used, the shoes are placed in the chutes by the assemblers, thus eliminating an operator. Each end of the machine will handle an average of from 6 to 8 shoes per minute, and one operator can easily serve both ends of the machine.



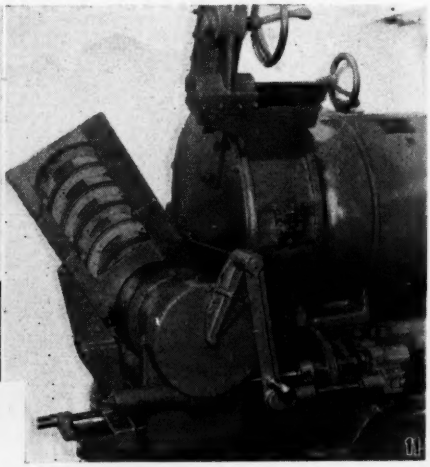


Fig. 10—A double disc grinder equipped with fixtures for automatically grinding brake shoes. Fig. 11—Chute loaded with shoes.

Commercial aviation in 1928 increased more than 100 per cent over 1927 in mileage flown and tonnage carried. New capital is being invested in aviation at an average rate approximating $2,000,000 daily, and the number of airports in service throughout the country has increased 50 per cent during the past year.

The automobile industry established a new high record in production during the first quarter of the current year, the January and February production figures showing a 56 per cent increase over a year ago.

Making Rubber Tire Molds

(Continued from page 12)

of a milling machine, as shown in Fig. 10. Here a dowel slot is milled so that the two halves of the mold can be quickly aligned when in use. A half of a finished mold which was made for a rubber manufacturer in Scotland is illustrated at the head of this article.

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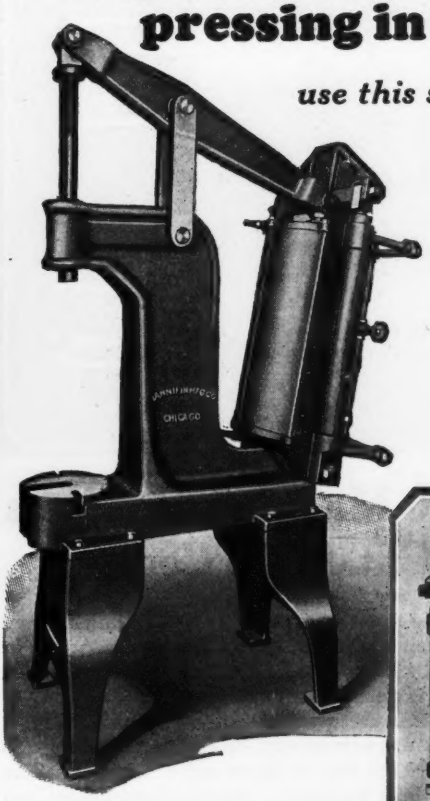

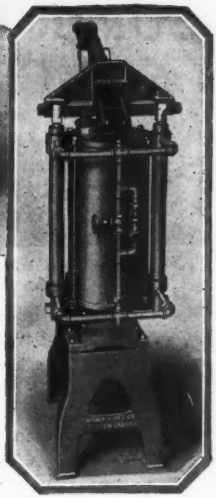

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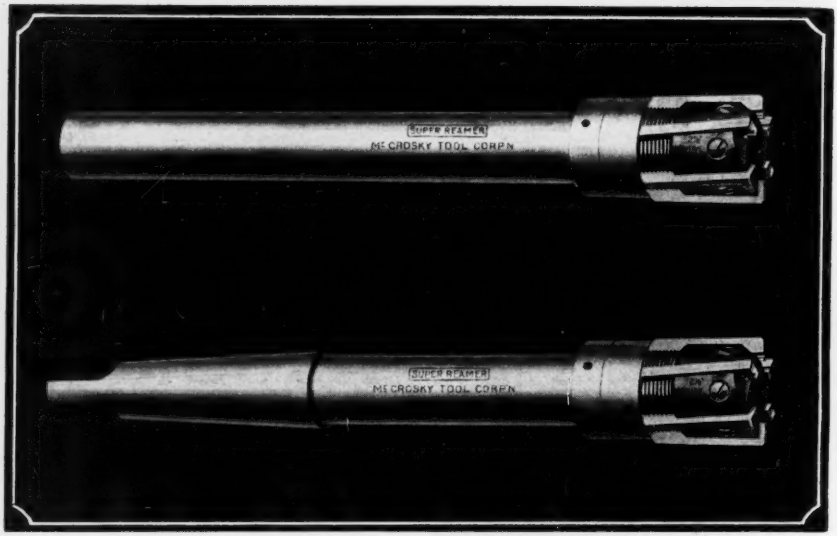

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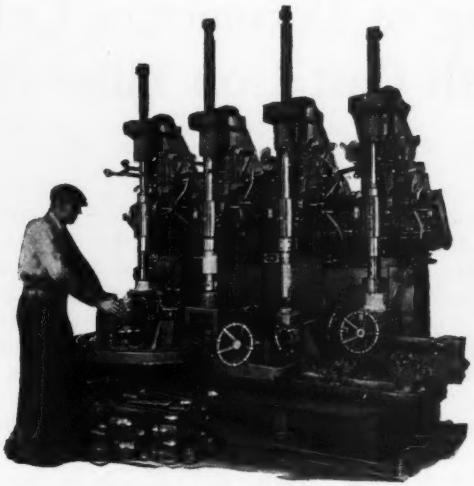

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Welding of Locomotive Cylinders With Cast Iron Filler Rod

By JAS. M. VOSSLER
Welding Instructor, Southern Pacific Lines

THE repairing of cracked or broken locomotive cylinders has always presented quite a problem to locomotive repair shops, but the development of the various processes of autogenous welding has tended greatly toward the simplification of this problem. It is to the autogenous welding process employing the oxy-acetylene torch to fuse a cast iron filler rod into the parent metal of the cylinder that this article will be devoted. When this process is properly handled, an ideal cylinder repair will be effected in that the repair will be made by depositing a filling material into the fracture which is almost identical with the metal of the cylinder casting and will, if properly handled, be of the same degree of hardness.

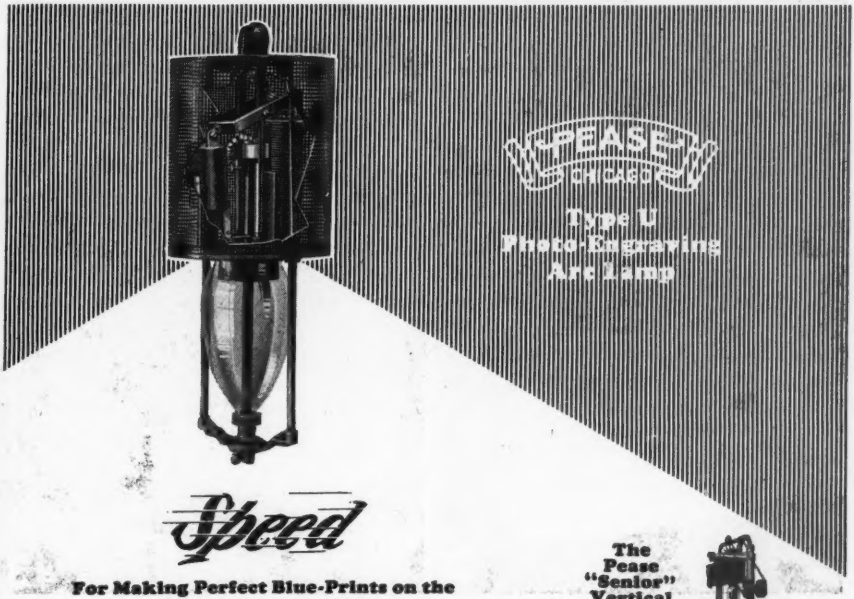
A thorough and very careful examination of the cylinder should first be made to determine whether there are any cracks or fractures which were not apparent at first. Failure to find all of the cracks the first time may cause a second weld to be made, which may cost as much or even more than the first. Experience has shown that it is well, with piston valve cylinders, to remove the valve bushings before a weld is made in any location on the casting, so that the port walls can be thoroughly examined to see if any cracks exist.

After proper examination has been made of the cylinder, it should be stripped of all parts which might interfere with the welding operation, or parts which will be damaged by the heat of the welding operation. The engine truck wheels should be removed, as same are in the way of the furnace, and jacks or other supports should be placed beneath the front bumper casting to support the weight of the front of the locomotive. As the cylinder must be heated to a point which may permit the frames to sag, due to the weight upon them, a jack should be placed under the cylinder castings, midway between the frames.

Fig. 1—Fracture chipped out for welding.

After all necessary stripping and the placing of auxiliary supports has been completed, the fracture should be vee'd or chipped out to an angle of from 80 to 90 degrees, opening to the side from which it will be easiest for the welder to work. Where possible, the fracture should be cut to center from both sides, as considerable time and material are saved by so doing; however, it is seldom possible to do this due to difficulties encountered in furnace construction. Fig. 1 illustrates proper angle of veeing.

The cylinder must be heated to the temperature described below before the actual welding is started, and maintained at the same temperature during the entire welding operation.



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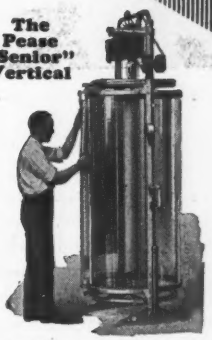

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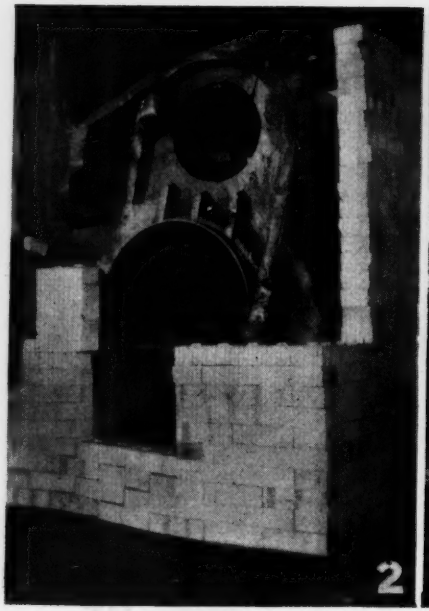


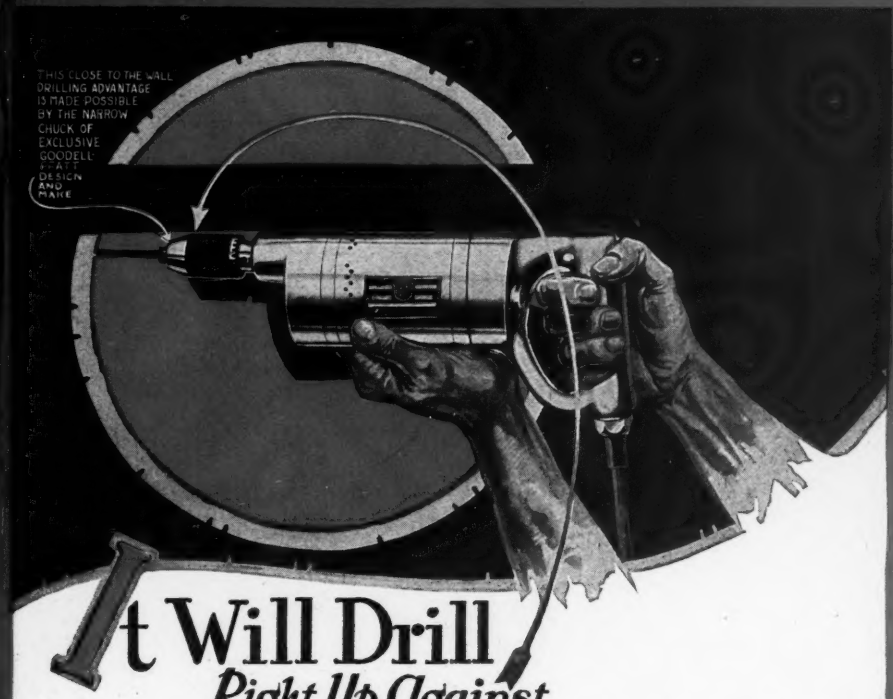
Fig. 2—Partly-constructed furnace for welding locomotive cylinder. Fig. 3—Furnace closed after completion of weld.

This heating is necessary for the following reasons:

(1) To prevent the further breaking of the casting due to the heat of the weld or the breaking of the weld due to unequal contraction during cooling. (2) To prevent the weld metal and heated metal close to the weld from being hardened due to the chilling action of adjacent cold or nearly cold metal. (3) To save welding gases and time. (4) To make welding easier. To preheat the casting properly, the cylinder casting must be enclosed in a furnace or its equivalent.

The building of the furnace is one of the most important operations of the process and only too often too little attention is paid to it. It is best to enclose the entire cylinder half within a furnace built of fire brick; however, when the weld is only a small one in the bottom of the cylinder proper, only the cylinder and valve need be enclosed, but in this case the saddle portion of the cylinder casting should be covered with asbestos to hold such heat as is transferred to the saddle.

During the welding operation on a cast iron locomotive cylinder, the casting should be maintained at about a dark cherry red heat. This can only be done by building a good tight furnace around the cylinder, so as to maintain an even temperature throughout the casting. It is obvious that, taking the economy as well as the success of the weld into consideration, it is best to adapt a type of furnace that will answer for all types of cylinder welds. With this in mind the author has adapted the fire brick type of furnace illustrated in Figs. 2 and 3, and described in the following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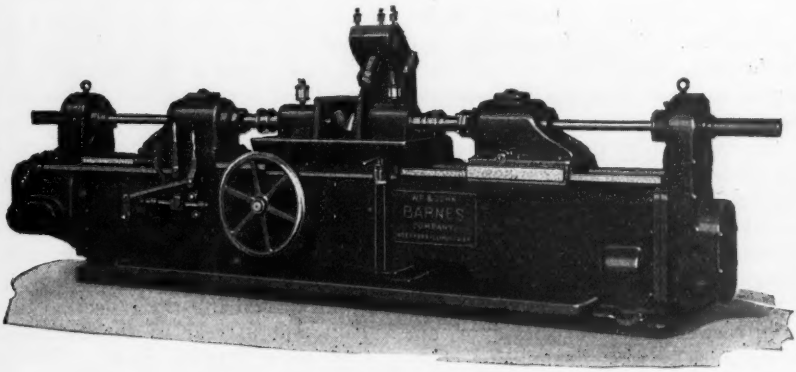

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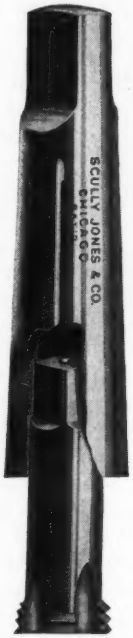
paragraphs. It may appear that to build a furnace requiring from three to six hundred fire brick is quite an expensive proposition, but when the facts are considered the actual cost per weld is low. The charcoal fire placed in the furnace does not damage the fire brick sufficiently to be considered; the principle source of damage being from the handling of the bricks. On railroads using oil as fuel for locomotives the bricks can be used in the locomotive fireboxes after the weld is finished, otherwise the bricks may be stored until they are again needed.

Fig. 2 illustrates a furnace under construction. As a foundation for the furnace, three rails of sufficient length to span the pit and extend about eighteen inches beyond the side of the cylinder were used. One rail was placed beneath the center of the cylinder and two others were placed, one about ten inches in front of the cylinder, and the other at a point about the same distance from the rear of the cylinder. These rails can generally rest on the track and floor, but the distance between the burning charcoal and the bottom of the cylinder must be taken into consideration. This distance should be not less than four inches, nor greater than about eight; thus figuring six inches for distance from burning coal to bottom of cylinder, five inches of coal and the two inches of sand mentioned below, the top of the rail should be about thirteen inches below the bottom of the cylinder. If this distance is greater than fifteen inches, the rail should be blocked up.

The possibility of the bottom of the cylinder sagging, due to the temperature to which the cylinder must be raised in preheating, should be precluded by the use of a support, consisting of a pier built beneath the cylinder and on top of the floor plate. It is best to make it of old iron, such as old frame jaw shoes, an engine truck journal box, or similar reasonably solid articles that will reach to within about an inch of the bottom of the cylinder. On top of this pier a wedge should be placed, so that it will come within about three quarters of an inch of the cylinder. When the bottom of the cylinder starts to get red hot the wedge must be pushed lightly against it. The additional expansion from that temperature to the final heating will tighten it sufficiently. If the cylinder is a long one, two piers should be provided. If the pier does not come over a rail, blocking must be placed between the floor and the bottom of the furnace floor to support the pier.

A piece of scrap steel plate, about ¼ or ⅜-inch thick, of sufficient width to extend from the splice between the two cylinder castings to the end of the rails, and of sufficient length to slightly overhang the rails that are in front and in rear of the cylinder, is used as a furnace floor. This size plate is necessary since the furnace should include the entire cylinder half. A grate for the cylinder, as seen in Fig. 2, can be made by punching ⅝-inch holes, spaced about three inches apart, in a piece of scrap boiler plate. The length of the plate should be about the same as the cylinder, and the width sufficient to locate it at a distance from the bottom of the cylinder about equal to a third of the cylinder diameter. A similar grate is placed in the valve chamber. The walls of the furnace are next started, and after same have been built two or three bricks high, about two inches of sand, ashes or common earth is spread over the



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floor plate to prevent overheating same. The furnace is then charged with charcoal. Generally about one sack of charcoal is placed in the valve chamber, two sacks in the cylinder, and three to six spread on the sand beneath the cylinder, depending on the size of the cylinder. The building

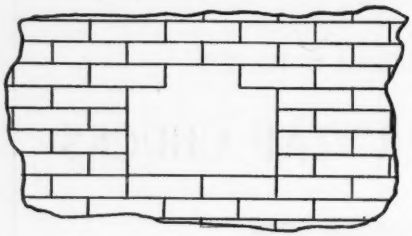


Fig. 4—Construction of fire door.

of the walls of the furnace are then carried to completion, as herein described. The walls are so located that they will be about six inches from the cylinder casting on all sides, the end walls extending from the side wall across the frames to the splice between the two cylinder halves. At this latter point is another wall running from the front end wall to the rear end wall, and extending to the cylinder casting in front and in rear, and up to the casting from beneath. Any gaps that are left between the bricks of this latter wall and the cylinder casting are closed with pieces of scrap asbestos boiler lagging.

It is obvious that it is necessary to leave openings in the walls of the furnace through which the welding operation can be performed. Likewise doors are left for the inspection and maintenance of the fire. A fire door should be placed in the side wall for the benefit of the fire beneath the cylinder, another should be placed opposite the valve chamber, and another opposite the cylinder chamber in at least one of the end walls. Since welding is generally performed on the front of the cylinders, fire doors are usually placed in the rear wall so that the fire can be cared for without interfering with the welder. Furnace fire doors are generally constructed as shown in Fig. 4.

Now let us consider Fig. 2 carefully. The fixed portion of the furnace is shown completed. The fire doors have been placed in the rear wall. It will be noted that the furnace was constructed of lock-type brick, the advantage of which is self-evident. Due to the nature of the fracture, it was necessary to leave most of the front wall removable. The balance of the side and end walls were so stacked in with non-locking brick and scrap asbestos boiler lagging that portions of it could be removed as needed without interfering with the balance of the removable portions of the wall. It is, of course, generally necessary to remove more of this wall than the welder requires for a hole through which to work. A sheet of one-eighth inch sheet asbestos is hung over the opening, and a hole is cut in it through which the welder works. This is done to keep

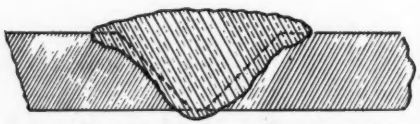
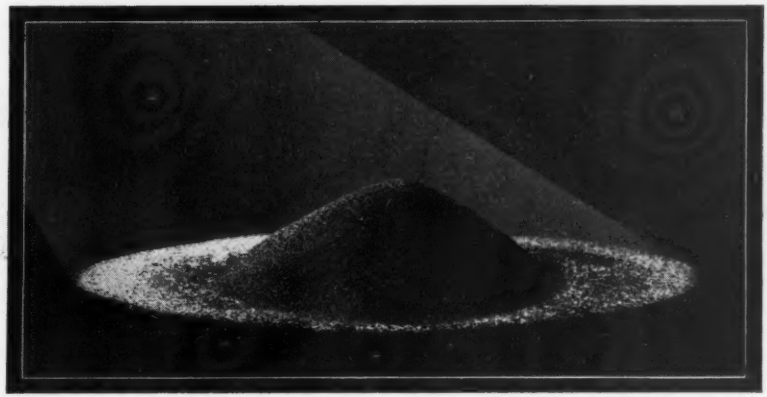


Fig. 5—Cross-section of finished weld.

the opening as small as possible, so as to hold the heat within the furnace and to prevent as much cold air as possible from entering the furnace.

The fire doors are closed by stacking fire brick or scrap asbestos boiler lagging in them. The top is closed by placing scrap pipe or flues across



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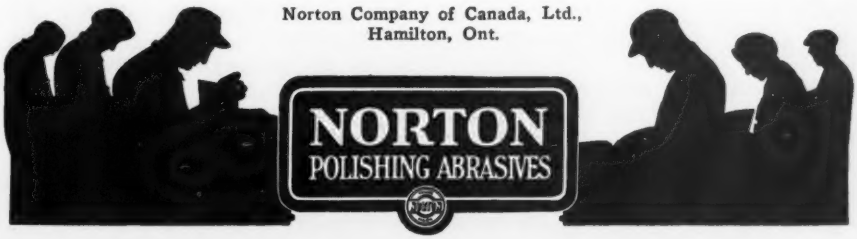

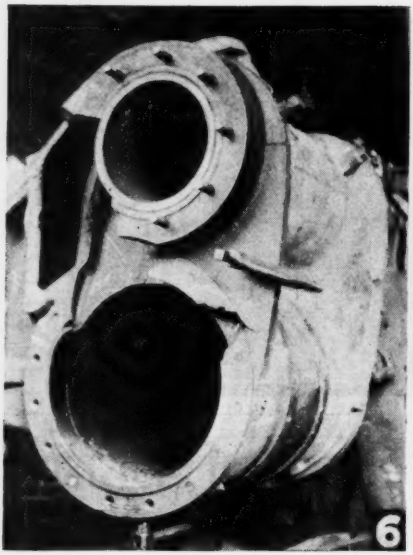

Fig. 6—Cylinder with entire front end of valve chamber broken off. Piece is shown clamped in position for welding. Fig. 7—Completed weld along edge of steam port.

it in rafter fashion, and covering them with ¼-inch sheet asbestos. The flues will hold the sheets high enough from the walls to permit the burnt gases to escape during the welding operation.

If the welding is to be done on the bottom of the cylinder only, it is only necessary to build a fire beneath the cylinder proper, but if welding is to be done on the sides of the cylinder or any portion of the valve chamber, fires should be built in the cylinder and valve chambers also. Unless welding is to be done on or near the saddle portion of the cylinder casting, fire is seldom placed beneath the saddle.

Fig. 3 shows a picture of the furnace illustrated in Fig. 2 after it had been closed upon completion of the weld. The bottom and side portion of the furnace was closed with a locking type of fire brick, while the upper front portion was closed with scrap asbestos boiler lagging.

Before starting the fire, the asbestos roof sheets are spread apart to provide plenty of opening for escape of burnt gas at start, and such bottom draft holes as are provided are opened. The side fire door is opened and if the coal is damp a little heavy oil is poured over it. The coal beneath the cylinder is then set afire, but no fire is as yet put to the coal in the cylinder and valve chamber. The coal in the latter two chambers is allowed to catch fire from the heat of the fire of the coal beneath the cylinder. By starting the fire in this manner, the casting is brought up to the desired heat more gradually than if the coal in all three locations were fired at the same time. As soon as the coal beneath the cylinder is burning good, the fire door and the opening made between the asbestos roof sheets are

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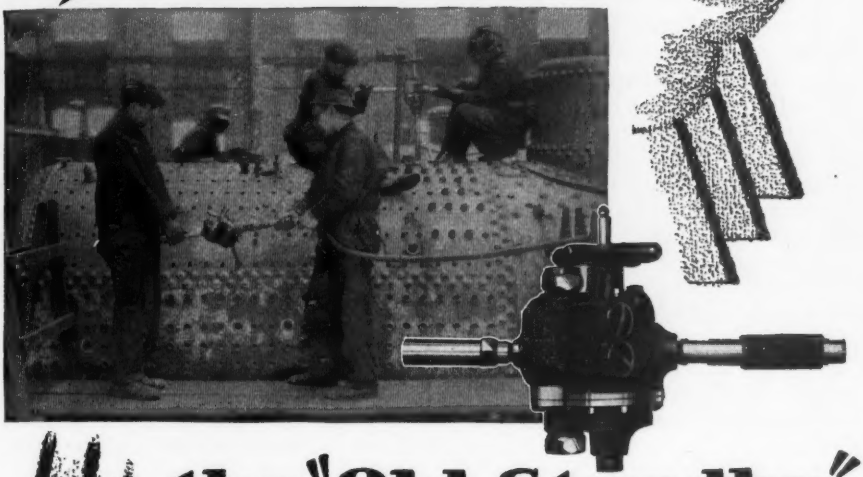

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closed. The space made by the rafter pipes between the asbestos roof sheets and the brick wall will be generally found to provide ample escape for the burnt gases when the fire is burning good.

If the weld is on the bottom of the cylinder proper only the lower portion of the cylinder needs to be brought to a cherry red heat; if the weld is to be made upon the upper portion of the cylinder, or the valve chamber, the entire valve and upper portion of the cylinder must be brought up to the same heat. The saddle portion of the cylinder should not be brought to a red heat unless it is to be welded upon. It is necessary only to heat such sections that are not to be welded to a temperature high enough to prevent them from chilling the portions that are to be welded.

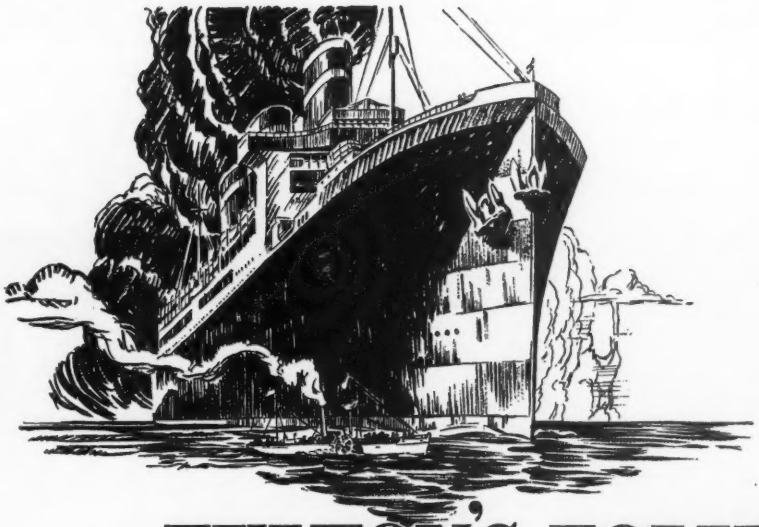
The cylinder should take from two to four hours to be brought up to the temperature described above, and no means should be used to force the heating, as it is important that the heat be brought up slowly. Rapid heating is liable to cause the cylinder to crack.

When the cylinder has reached the dull cherry red heat, the place in the wall through which the welders are to work should be opened, by removing the brick or scrap boiler lagging with which the opening was closed, and a sheet of $\frac{1}{16}$-inch asbestos placed over the opening. A hole should then be made in the sheet of asbestos just large enough for the welder to work through and no more. If the break is such that two welders can work near each other, holes should be provided for it, but it is not advisable for one welder to work on one end of the cylinder and one on the other, as this may permit a draft to pass through the furnace, chilling and hardening the cast iron. It may even cause the casting to crack. As these jobs are almost always too hot for one man to work at it continuously without relief, two welders should be used, taking turns at the torch. If two torches are used, three welders will be sufficient.

It will be found best to use a gooseneck type welding torch on cylinder welds, using an extension to lengthen it to proper length for the job. A make of torch should also be chosen that is known to stand high temperatures well without backfiring too frequently. Even the best torch will be found to occasionally backfire, due to the high temperature within the furnace, and it may be necessary to wrap it with a thin, narrow asbestos braid from the mixer to a point close to the end of the tip. This will be found to be a great help in holding the backfires to a minimum, and in most cases will prevent them.

Care should be exercised to see that the welder is supplied with a good quality of cast iron welding rod and flux. On the majority of such jobs $\frac{1}{4}$-inch rod will be found to be the best size; however, if the section of the cylinder to be welded is thick, $\frac{3}{8}$-inch rod may be used.

It is practically impossible to make a fixed rule as to the proper point to start the weld. Experience alone can determine this; however, if the cylinder is kept at the proper heat during welding there is very little chance of mistake in this respect. Experience must determine the size of welding tip to be used, but the length of the flame must be sufficient to prevent the encouragement of backfires, although not of sufficient length to have enough blast to blow the molten



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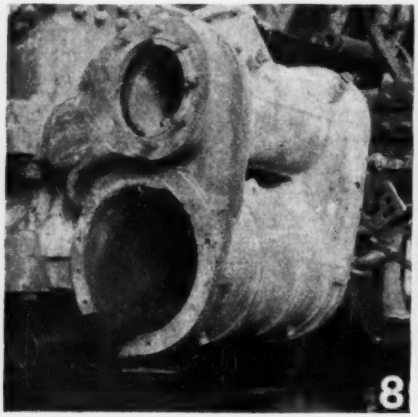
metal around. Care should be exercised to keep the flame neutral.

The welder must be careful to avoid hard spots in the weld, as they interfere with the machining of the cylinder after welding. The principal cause of these hard spots is the plunging of cold welding rod into the puddle, which chills the molten metal. The excessive use of flux as well as the use of an inferior quality of flux will also cause hard spots.



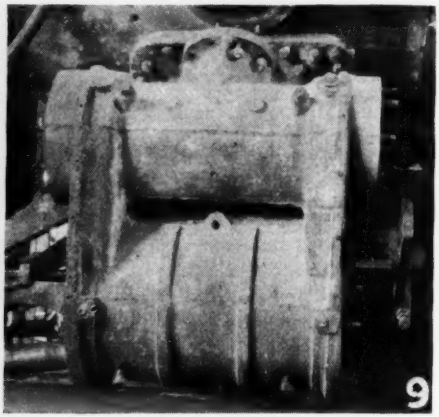


Fig. 8—Front view of welded cylinder, showing false bushing melted away to make part of the weld. Fig. 9—Side view of weld.

In starting the weld, the welder should spread the flux sparingly over the cast iron at the point of starting. He should then play his flame over the cast iron at this point until the walls of the vee-shaped groove described above begin to melt. Care must be exercised to see that the metal at the outer portion walls of the vee does not melt ahead of the metal at the apex of the vee, and thus flow over the apex and not weld to it; but that the surfaces of both are brought to the melting temperature at the same time. When this temperature is reached, the end of the welding rod, which has previously been heated and dipped into the flux, should be brought to a bright red heat. It should then be placed into the puddle prepared as described above and rubbed about so that, as it melts, the molten metal will be fed into the puddle beneath the surface. Molten metal should by no means be dropped into the puddle, as it will tend to cause slag enclosures and blow-holes in the weld. The surface of the puddle should be closely watched, and when it appears dirty, more flux, in small quantities, should be added. When necessary to remove the impurities, do not push them aside, but lift them off.

Too much care cannot be exercised in seeing that the added metal from the filler rod properly unites with the parent metal of the casting. Too often surface adhesion is mistaken for a true weld. In order to secure a true weld the welder must see that the walls of the parent metal are melting and mixing with the filler rod metal. Unless the parent metal actually melts at the surface, there will be no true weld. By constantly rubbing the filler rod into the molten metal of the puddle the welder will be able to judge

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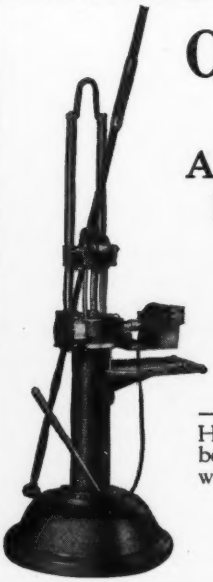

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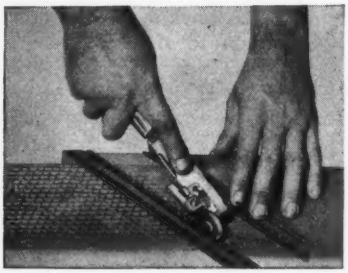

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the penetration he is getting into the parent metal. The weld should be finished off about as shown in Fig. 5. A heavy reinforcement is seldom necessary, as surfaces that must be machined will permit of no reinforcement at all.

We now come to one of the most important steps in the operation, and that is the cooling. Since care must be exercised to see that the cylinder is slowly and carefully brought up to the proper preheat, and in seeing that the casting is not chilled during welding, it is only logical that the same care should be exercised in lowering the temperature of the casting to room temperature. When the weld is completed, the furnace must be recoaled and then closed up as during the preheating. The casting should then be closely watched to see when it is down to a uniform dark cherry red heat. Just as soon as it has reached this heat all openings must be closed with pieces of scrap asbestos lagging. Small openings between the brick that cannot be closed in this manner should be plastered over with a paste made of ground scrap asbestos lagging and water. If a large opening in any of the walls is closed with scrap asbestos lagging, and there is any danger of it falling, it should be plastered over with the asbestos paste. From 36 to 48 hours will be required for the casting to cool. The furnace should not be opened until from 10 to 12 hours after the walls of the furnace have become cold, and then only a small opening should be made at first and the hand reached into the furnace to determine whether or not the casting has cooled sufficiently. If it is found to be sufficiently cool, enough of the furnace should be removed to make a thorough examination to see that there are no imperfections in the weld. If additional welding is required, the casting can be reheated; otherwise the furnace can be removed.

In Fig. 6 will be seen a badly broken cylinder. The entire front end of the valve chamber was broken off. The fracture started, as shown, at the right of the cylinder and progressed upward along the steam port, through the valve observation hole and around to the exhaust port. The part broken from the casting was fractured into eight pieces. The largest piece comprised about three-fourths of the front end of the valve chamber and the right half of the front wall of the steam port. This latter-mentioned piece was supported by a false bushing, placed in the valve chamber as shown in Fig. 6. The other pieces were brazed to the ends of long pieces of pipe and when the time came to place them in position, the pipe handle was passed through a sling used as a fulcrum and held in the hook of an overhead traveling crane. This enabled one man, after the pieces were properly preheated, to hold them in place while the welder tack-welded them to the cylinder casting and then melted the braze that held them to the pipe. Fig. 7 shows the completed weld along the edge of the steam port, including the valve observation hole. The completed job is shown in Figs. 8 and 9, showing how the false bushing was melted away in order to make part of the weld. When the above described procedure was followed the writer has never experienced any trouble with any cylinder weld.

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The Nature and Properties of Iron and Steel. V.

By George M. Enos
Assistant Professor of Metallurgy, University of Cincinnati

This is the fifth article of the series and deals with the constitution of steel. The next article will consider the heat-treatment of plain carbon steels.

PLAIN carbon steel is an alloy of iron and carbon, usually containing appreciable quantities of manganese. In commercial steels, silicon, phosphorus and sulphur are also present in small amounts. Alloy steels owe their properties to some element or elements which have been added to plain carbon steel, such as tungsten, vanadium, nickel or chromium, or to increased amount of meganese or silicon.

Since steel is an alloy, a study of the constitution of steel should follow the usual lines of procedure for the study of alloys. An alloy may be defined as a metallic mass which is not a single chemical element. The study of the constitution, or internal structure, of metals and alloys is a branch of metallurgy known as Metallography. Plain carbon steel may be considered as alloys of only iron and carbon, for purposes of fundamental explanation of their constitution and properties. Consideration of the effects of the other elements will therefore be postponed.

Steel and cast irons comprise a system of alloys between iron and carbon. Up to about 1.7 per cent carbon the alloys are known as steel. From 1.7 per cent to 6.67 per cent carbon the alloys are cast irons. The variation in carbon percentage has a very great influence upon the properties of the steel or cast iron.

At the outset it should be clearly understood that it is impossible, in a brief article or series of articles, to

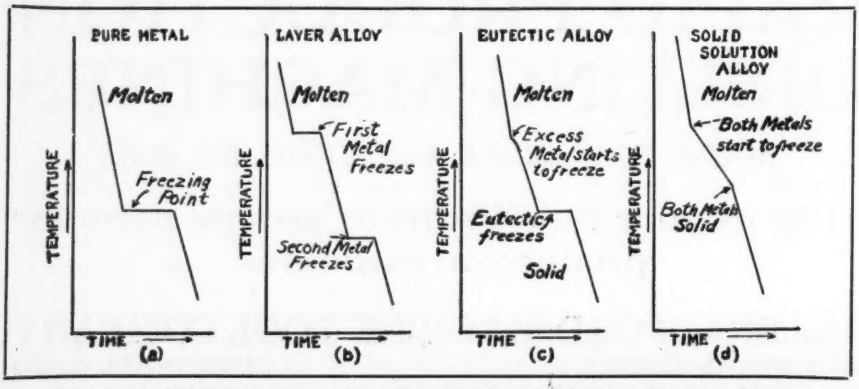

Fig. 1—Typical Cooling Curves for a Pure Metal and for Various Types of Alloys.

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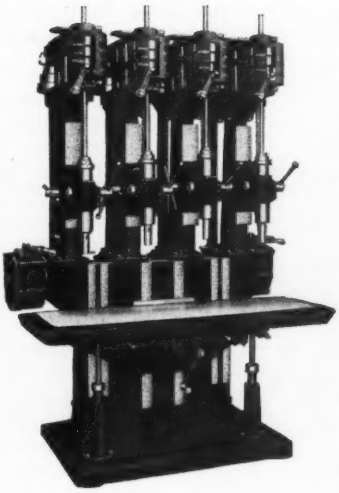

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give a complete discussion of all the possible variations in the structures and properties of iron and steel. To introduce the subject of the constitution of steel, it is advisable to consider alloys in general before taking up the constitution of steel in any detail.

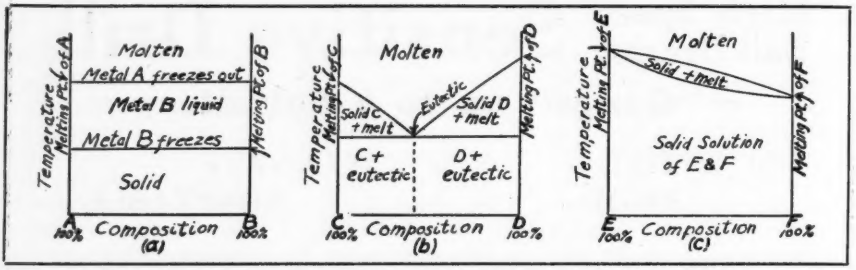

Fig. 2—Typical Equilibrium Diagrams for Various Simple Alloy Systems.

The methods of production of iron and steel have been considered in previous articles.

Alloy Systems

When metals are allowed to solidify together from the molten state, the mechanism of this process, and also changes which may occur in the solid state, depend upon certain conditions of solubility. Metals may dissolve in each other just as salt dissolves in water, up to certain limits, or they may not dissolve at all, just as sand will not dissolve in water. The possibilities are summed up in the following cases.

CASE I. The metals are not soluble in each other in either the liquid or solid state. No compounds are formed. Alloys of this type, upon melting, will form layers with the heavier metal at the bottom of the containing vessel, and accordingly are sometimes called "layer" alloys. Lead-copper alloys, which are sometimes used for bearings, belong to this class.

CASE II. The metals are completely soluble in each other in the molten state, but are insoluble in the solid state. No compounds are formed. In this case the metals cannot be distinguished from each other when molten, but upon freezing, the constitutent metals separate, forming a finely divided mechanical mixture called a eutectic. The composition of the eutectic is constant, so that if the metals in the alloy are present in proportions other than the original composition, an excess of one of the metals will freeze out distinct and separate from the eutectic. Cast iron belongs to this class of alloys, as do several types of bearing metals, such as lead-antimony alloys.

CASE III. The metals are soluble in each other in all proportions in the liquid and solid states. No compounds are formed. Alloys of this type are known as "solid solutions." Steel at very high temperatures is a solid solution. Another example is cupro-nickel, which is an alloy of copper and nickel.

Under certain conditions compounds may be formed between metals. If this occurs, the cases just discussed may be somewhat complicated. It is possible to have different cases applying in the same alloy system. Thus, as indicated above, in the iron-carbon system, cast irons solidify as a "eutectic" type alloy, while steel solidifies as a "solid solution." On cooling below certain temperature ranges, steel behaves as

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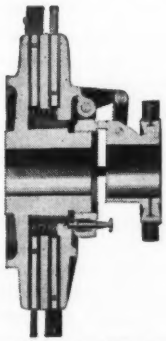

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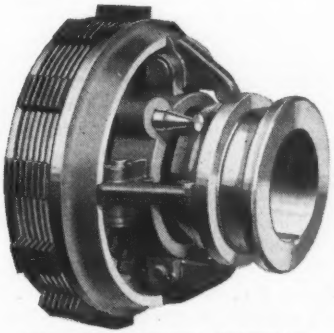

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though it were a eutectic type alloy.

In considering alloy systems we are concerned with variations in temperature and composition. (The effect of pressure may be neglected.) For alloys containing only two elements, these variations may be shown on a

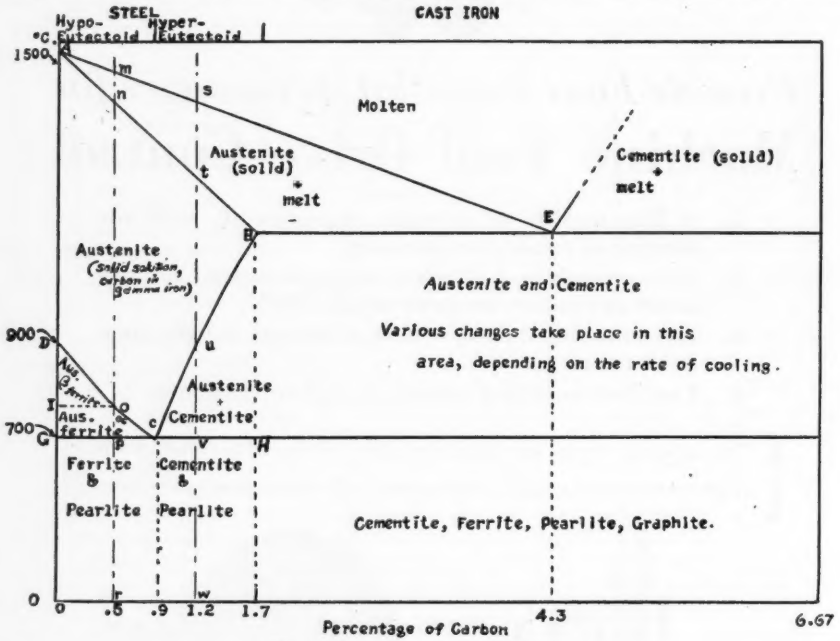

Fig. 3—The Iron-Carbon Diagram.

diagram known as a "constitutional" or "equilibrium" diagram. The data for these diagrams can be obtained by noting the temperature at which alloys of the same system but of various compositions freeze and melt, and by examining the alloys under the microscope, and in other ways. Typical cooling curves for a pure metal, and also for alloys of each type, are shown in Fig. 1.

Let **A, B, C, D, E, F,** represent different metals. In Fig 2 are shown typical equilibrium diagrams for pairs of these metals. It will be observed in (a) Fig 2, that metal **B** has no effect on the melting point of metal **A**, or vice versa. In (b) metal **D** lowers the melting point of metal **C**, and vice versa. In this example an alloy rich in metal **C** has a lower melting point than the pure metal **C** because of the presence of metal **D**, and likewise an alloy rich in **D** has a melting point less than **D** because of the presence of **C**. The alloy having the eutectic composition has the lowest melting point. For the pair of metals **E** and **F**, the addition of **F** to **E**, or vice versa, changes the melting point from that of the pure metal. The data for obtaining (a), Fig. 2, would be obtained from a series of cooling curves similar to (b) in Fig 1, for (b), Fig 2, from (c) in Fig. 1, for (c), Fig. 2, from (d) in Fig. 1.

It should be noted that equilibrium diagrams can be used in interpreting alloy systems only when the

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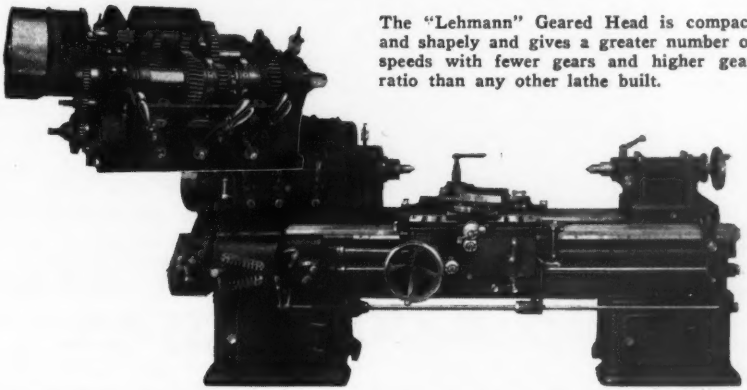

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alloys formed are cooled very slowly from liquid to solid state.

Iron-Carbon Equilibrium Diagram

We are now ready to consider the iron-carbon equilibrium diagram shown in Fig. 3. Strictly speaking,

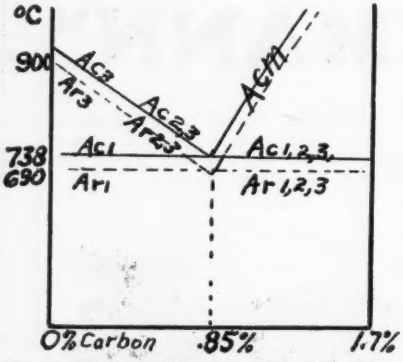

Fig. 4—Diagram Showing "Eutectic" Type Changes in Solid Steel upon Heating and Cooling.

the iron-carbon diagram, as conventionally depicted, is really an equilibrium diagram showing the relationships between iron (ferrite) and iron carbide, or cementite, the formula for which is Fe_3C. Since cementite contains 6.67 per cent carbon, the limit of the diagram in terms of carbon is placed at 6.67 per cent carbon, which is equivalent to 100 per cent cementite.

Pure iron melts at 1530 degrees C. (2786 degrees F.) The effect of the addition of small amounts of carbon on the melting point is shown by the lowering of the melting point indicated by the line **AE**, until at the eutectic point **E**, the melting point of the alloy is about 1135 degrees C. (2075 degrees F.), and the composition is about 4.3 per cent carbon and 95.7 per cent iron. The diagram can be considered as consisting of three parts; viz., the part showing cast iron as a eutectic alloy, the part showing steel as a solid solution, and the part showing the steel in solid solution breaking up in the solid state, just as eutectic alloys do upon solidification. The solid solution known as austenite holds carbon dissolved at the higher temperature, but loses this property as the temperature passes through a temperature range known as the "critical range," and below 700 degrees C. the amount of dissolved carbon will be extremely small. Point **C** is equivalent to a eutectic point, and is called "eutectoid" to distinguish from the true eutectic. The eutectoid com-

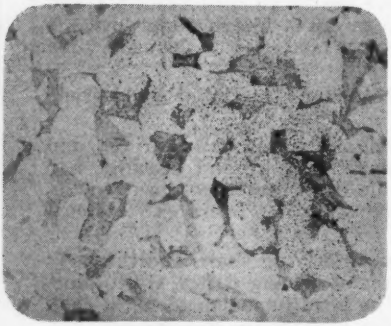

Fig. 5—Photomicrograph of a Hypo-Eutectoid Steel, .6 per cent Carbon (Fully Annealed), Etched with Picric Acid, X 100, Showing Pearlite (Dark) and Ferrite (Light).

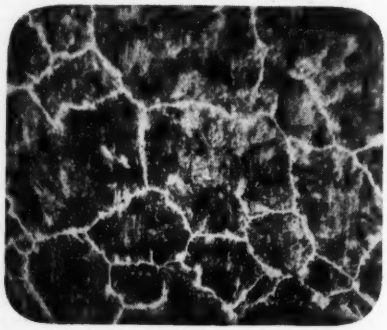

Fig. 6—Photomicrograph of a Hyper-Eutectoid Steel, 1.4 per cent Carbon (Fully Annealed), Etched with Picric Acid, X 100, Showing Pearlite (Dark) with Cementite (White) at the Grain Boundaries.—(R. O. MacDuffie).

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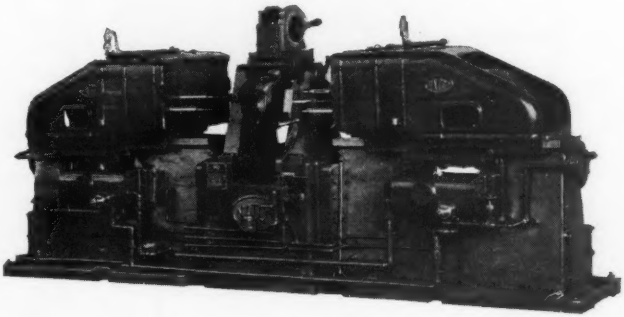

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position is about 0.85 per cent carbon. Heat treating operations are concerned with the changes which take place in steel in the solid state on heating and cooling. The "eutectic type" changes in steel are indicated in Fig. 3, and in more detail in Fig. 4. This illustration shows values obtained with cooling curves as dotted lines, and values obtained from heating curves as full lines.

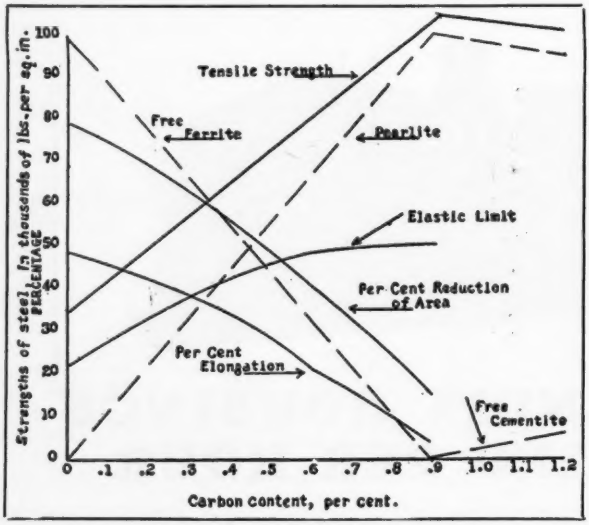
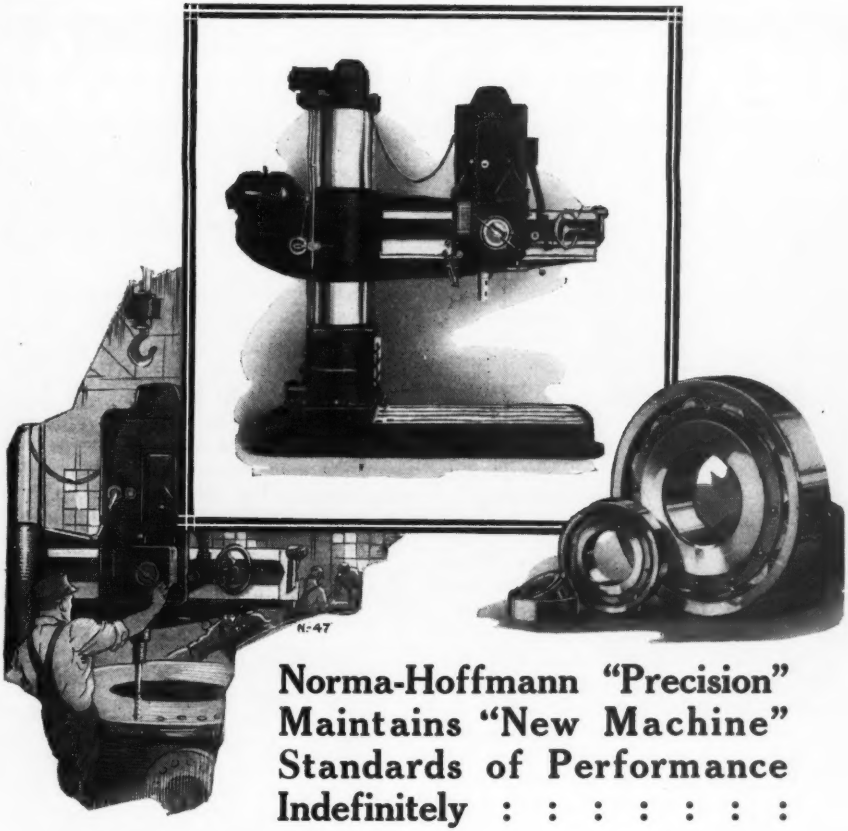


Fig. 7—Physical Properties of Steel, with respect to Carbon Content.

Consider the slow cooling of two typical steels from the liquid state to room temperature. One steel contains 0.5 per cent carbon and the other 1.2 per cent carbon, represented on the diagram Fig. 3 by the lines **m, n, o, p, r** and **s, t, u, v, w** respectively. (The dashed lines are not a part of the original diagram.)

At a temperature of 1530 degrees C. the 0.5 per cent carbon steel will be completely molten. As it cools to a temperature represented by point **m** it will start to freeze and the solidification of the solid solution, carbon in iron, will continue until all the metal is solid at point **n.** The austenite (solid solution) will then cool until a temperature corresponding to **o** is reached, where the spacing of the atoms changes, and the new spacing will not permit carbon to remain dissolved. The new material is called alpha ferrite. During the temperature drop, **o** to **p,** more alpha ferrite is formed, with a consequent enrichment in the carbon content of the solid austenite. At 700 degrees C. or thereabouts, the remaining austenite breaks down into iron carbide and ferrite, intimately mixed like any eutectic. This material is called pearlite and contains about 0.85% carbon, all of which is present in the iron carbide form. Accordingly the structure below 700 degrees C. will consist of the excess ferrite, thrown out of solution between **o** and **p,** and pearlite. Below **p,** the cooling continues without change of structure. Fig. 5 is a photomicrograph of a steel containing pearlite and ferrite.

Considering the 1.2 per cent carbon steel—at 1530 degrees C. it will be molten; it will start to freeze at point **s,** and the solidification continues until point **t** is reached. The solid steel is austenite, but contains more carbon than in the previous example. From **t** to **u** the cooling continues without change. At **u,** the austenite can no longer hold as much carbon dissolved as at the higher temperatures and starts to eject cementite, which pro-



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cess continues, with depletion of the austenite in terms of carbon, until a temperature of about 700 degrees C. is reached at v, where the austenite transforms into pearlite, just as it did at the same temperature for the lower carbon steel. The cooling continues

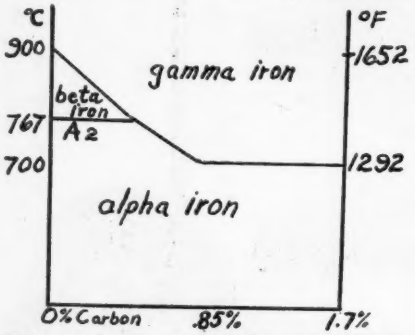

Fig. 8—Diagram Showing Allotropic Forms of Iron in Steel.

to room temperature without any change in structure. The constituents present will be pearlite and cementite.

All steels with less than 0.85 per cent carbon are known as hypo-eutectoid steels and will behave in a manner similar to the first example, and all those with more than 0.85 per cent carbon are known as hyper-eutectoid steels and will behave like the 1.2 per cent carbon steel. If the steel contained exactly 0.85 per cent carbon, no change would occur in the solid state until the temperature of 700 degrees C. was reached, when the austenite would transform completely to pearlite. Fig. 6 is a photomicrograph of a steel containing pearlite and cementite. Fig. 7 shows the variation in percentage of pearlite, ferrite and cementite in annealed (slow cooled) carbon steels, with carbon content, and also the changes in physical properties with carbon content.

The Allotropy of Iron

Iron is a metal which undergoes changes in its crystal form in the solid state at several different temperatures. Thus if the cooling curve of pure iron be studied carefully, it will be found to have arrest points at 768 degrees C. and 900 degrees C., as well as at the actual melting point of 1530 degrees C. (See Fig. 1(a) for cooling curve of a pure metal which does not have allotropic changes). These arrest points in the solid state are known as "thermal critical points." The addition of carbon to iron, forming steel, lowers the upper thermal critical point, as shown approximately by the line **DCH** in Fig. 3, and the lines **Ar 3, Ar 2, 3** and **Ar 1, 2, 3** in Fig. 4. For pure iron the distance between atom centers in the solid state is a constant value until a temperature of 900 degrees C. is reached. There the value changes. Below 768 degrees C. the pure iron is known as alpha iron; between 768 degrees C. and 900 degrees C. it is known as beta iron; above 900 degrees C. it is known as gamma iron. These allotropic changes are indicated in Fig. 8. Alpha iron is magnetic, but cannot dissolve appreciable amounts of carbon at any temperature. Beta iron is non-magnetic; gamma iron is practically non-magnetic, and can hold carbon dissolved in it. Unimportant in the subject matter under discussion here is delta iron, which exists above 1400 degrees C., and is not shown on the diagrams, Fig. 3 or Fig. 8.

In steel, gamma iron exists at successively lower temperatures as the carbon content is increased up to .85 per cent, after which the transformation temperature is constant at around 690-700 degrees C. Beta iron is found in the small area marked "beta" in Fig. 3 and Fig. 8, and alpha iron exists below beta and gamma.

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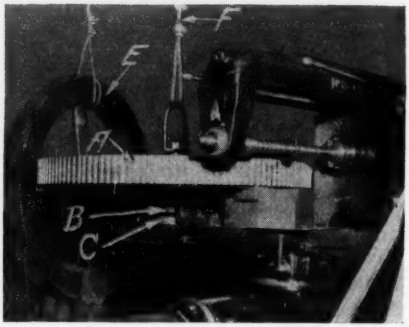
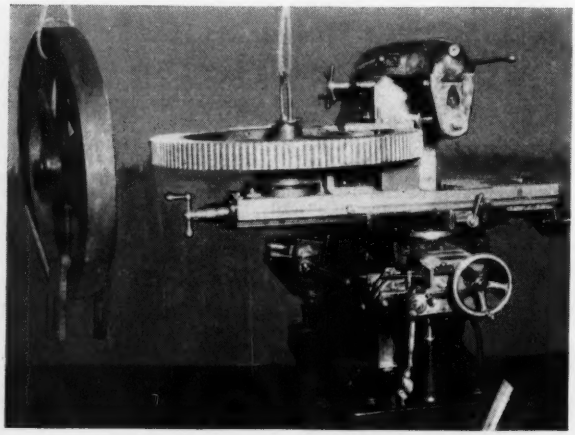


(A) Gear to be cut; (B) master gear for indexing; (C) flanged stud on which gear revolved; (E) counterweight; (F) steel connecting cable.



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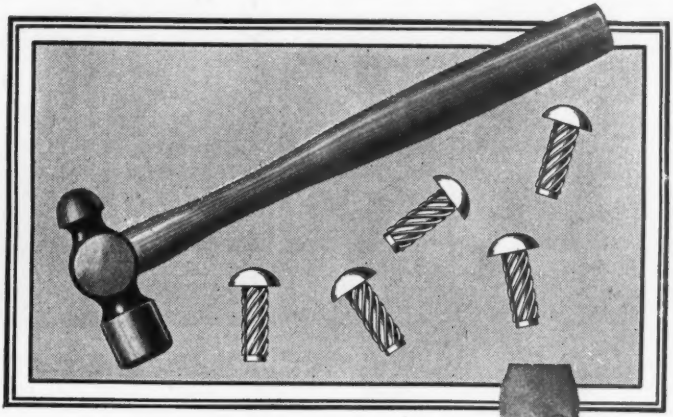

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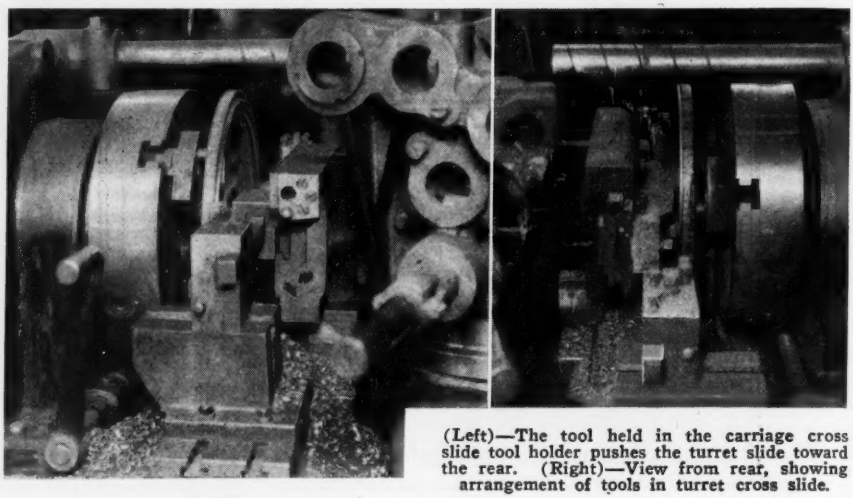

(Left)—The tool held in the carriage cross slide tool holder pushes the turret slide toward the rear. (Right)—View from rear, showing arrangement of tools in turret cross slide.

bolted to the milling machine table.

In order to accurately index and lock the gear, a piece of 2 x 6 x 6-inch angle steel was fitted with an adjustable latch in which several teeth had been cut to mesh with the teeth in the master gear. The angle plate was bolted to the machine table with just enough clearance between the master gear and angle plate to allow for adjustment of the latch. Two set screws held the latch in place when meshed with the teeth in the master gear.

This Turret Carries a Cross Slide

By WREN A. DAWSON

HERE is a set-up on a Potter & Johnson automatic lathe that makes it possible to face four surfaces, one of which is on the rear side of the piece, in one movement. The piece is a cast iron differential spur gear spider for a Hart-Parr tractor. The tools shown face the front side of the rim, face a counterbore to an exact depth and diameter, and face both the front and rear of the hub.

Obviously, the facing of the rim and the counterboring could not be done automatically with tools held in the cross slide, and wide facing tools of the type which are fed straight in but not crosswise were unsatisfactory. The solution to the problem lay in the use of a cross slide which consists of a casting that is held in the turret in the same manner as the other turret tools are held. The casting is planed out and has a sliding member gibbed into it. This sliding member, which carries the tools, is actuated by the carriage cross slide, being fed across by a short section of steel which is clamped into the side of the carriage tool holder.

When the turret moves up to position, it inserts a curved facing tool through the hole in the hub and stops at a point which locates the tools at the proper depth. The carriage cross slide then feeds toward the front, the front cross slide tool rough facing the rim, while the rear cross slide tool holder pushes the turret cross slide toward the front so that the tools held in the turret cross slide can perform the rough facing operations.

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Sixteen closely graded speeds, ranging from 263 to 1233 r.p.m., are provided by interchanging gears on three vertical shafts. At every speed there are only three gear contacts from driving shaft to spindle. Such flexible simplicity means continuous high production.

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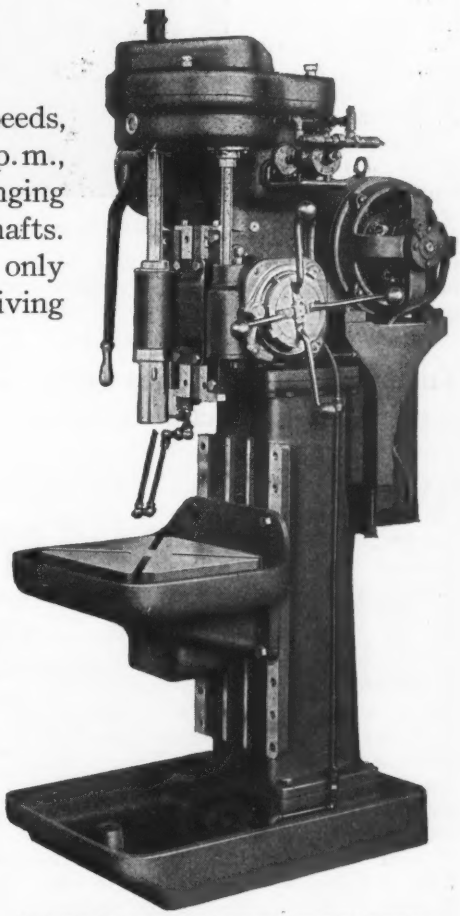
Instead of the ordinary sliding spindle sleeve, the spindle is attached to a slide with broad bearing surfaces like the ram of a punch press. This construction provides unusual stiffness and rigidity at the spindle nose. The result is less deflection, less drill breakage and more production.



20″ SUPER-SERVICE PRODUCTION DRILL

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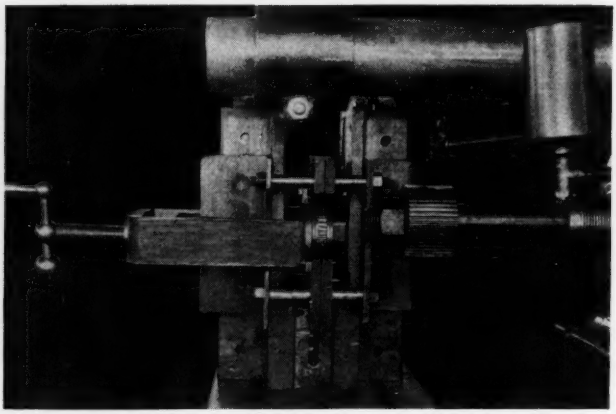
THE CINCINNATI BICKFORD TOOL CO.

OAKWOOD, CINCINNATI, OHIO

When the cut is completed, the tools reverse and the front cross slide tool finishes the rim face, at the same time pushing the turret cross slide toward the rear, while the tools perform the finish facing operations. The finishing tools are, of course, inverted.

This arrangement is used for facing hubs, counterboring, or for other facing operations where the surface to be faced is below the face of the rim. It is also particularly adaptable for back facing.



Milling machine attachment for turning crosshead pins.

Turning Crosshead Pins on a Milling Machine

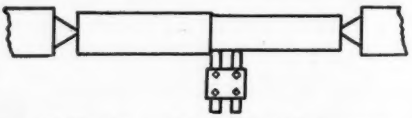
By H. E. BARNES

THE illustration shows a special attachment set up on a milling machine to turn crosshead pins on a four-bar guide for a crosshead. The turning tool, which must necessarily be held so that it can revolve around the pin, is clamped to a ring that is held between two counterbored plates. The tool projects toward the center of the ring, which is made in four pieces so that it can be placed in position around the pin. The plates are also made in sections so that they can be located around the pin. Teeth are cut in the outer edge of the ring so that it can be driven by a pinion that is held on a stub arbor in the spindle of the machine. The section that holds the plates and gear in position is fed back and forth by means of a 1¼-inch 10-thread brass screw, thus making it possible to turn the whole length of the pin. The illustration shows the table, carrying the work, drawn away from the pinion so that the teeth of the gear can be seen through the opening in the plates, which provides for meshing the gears.

A Test Method Applied to Practice

By R. H. KASPER

IN A TEST recently applied by the Bureau of Standards, two tools were set in a lathe tool post so that the cutting edges of both were the same distance from the axis of the work, as shown in the sketch. Repeated cuts taken off the work showed that the trailing tool would not cut while the leading tool retained its keen cutting edge. After the leading tool had worn about 0.002 inch, the trailing tool started to cut. This was



Using the cutting tools as limit gages.

(Continued on page 82)

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CHUCKS

Improved Design, Longer Life, Greater Power.

Single and Multiple Spindle.

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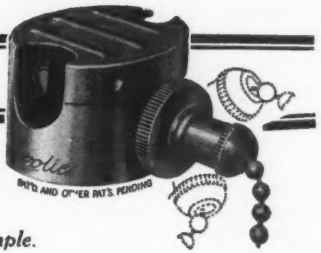

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MODERN Machine Shop

HOWARD CAMPBELL - - *Editor*

Should Old Methods Be Pensioned

WE RECENTLY heard of a man who had been complaining because his customers, who are obviously in business to make money, were transferring a part or all of their patronage to a new and live competitor. His particular claim to their business was based, it seems, on the fact that he had given them good service over a period of many years, and he felt that they owed it to him to continue their patronage, regardless of the fact that the newcomer, being unhampered by old-fashioned ideas and out-of-date methods of working, was able to give his customers better service all around at somewhat lower prices. Therefore the complaint.

We wonder what this man would say to a machinery dealer who, unable to understand or appreciate the necessity or advantages of modern machine design, would try to sell him an old-fashioned lathe for more money than would be required to purchase a modern geared-head lathe with quick-change gears and all the latest attachments. Would he buy another antique machine on the grounds that the old lathes had given him good service?

We wonder what his answer would be to a salesman who tried to sell him carbon steel tools instead of high speed steel, because the carbon steel gave him what was, thirty years ago, considered good service.

The great changes in business and industrial methods that are taking place today are coming so fast and are so far-reaching that only those who are capable of broad vision can keep pace with them. New processes and new methods are continually replacing the old methods and processes. The man who expects to maintain his place in his industry must be alive to developments and must be ready to profit by them, so that he can pass a part of this profit along to his own customers. If he cannot keep pace with progress, he belongs to a past age. And when he asks for patronage on a basis of past service, he is asking for a pension.

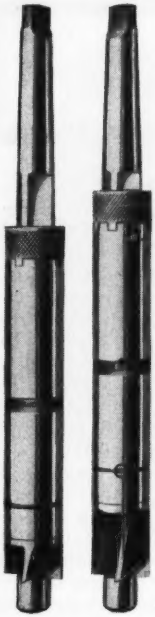
Business

BUSINESS conditions, as indicated by a survey made by The National City Bank of New York, are constantly growing better. Manufacturing plants in most of the major industries are operating at near-capacity; employment is large and steadily increasing. Steel mill production, which is considered a fairly good barometer of the metal-working industrial situation, is up to 95 per cent of capacity and the unfilled orders are piling up.

The automobile industry established a new high record in production during the first quarter of the current year, the January and February production figures showing a 56 per cent increase over a year ago.

Agricultural implement manufacturers expect this year to set another new record in the program of modernizing farm equipment, and implement dealers in the Central West and Northwest report the largest Spring business since the war.

With present conditions and future prospects so bright, no plant owner who has been looking forward to the installation of more modern equipment can afford to put it off longer.



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Eclipse Quick-Adjustable-Length

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IS THE IDEAL TOOL

ESPECIALLY adapted for multiple spindle spot facing, counterboring, countersinking, or core drilling to a specified depth.

Instant adjustment obtained by means of fine screw thread and sliding locking collar; no screws to set. To adjust for length, simply lift the locking collar by hand, revolve the holder on the shank until the desired length is obtained, then lower the locking collar so that it engages the body again. Adjustment is made without removing from spindle.

This holder will save its cost in a short time on production work.

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HIGH SPEED

CRANK SHAPERS

Designed for accurate work at high speeds, these machines will be found equally efficient on tool room work or production.

Made in sizes 12" to 32" stroke. 12", 14", 16", 20" and 25" with Gear Box single pulley belt driven or motor drive, also 16", 20" and 25" B.G. cone drive with belt shifter. 32" B. G. all geared single pulley belt drive or motor drive.

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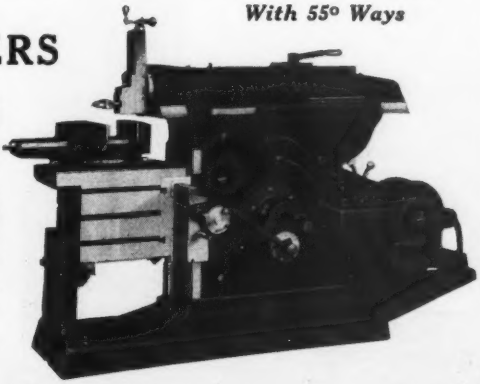
"V"-TYPE RAM

With 55° Ways



The SMITH & MILLS CO., Cincinnati, Ohio

New Shop Equipment

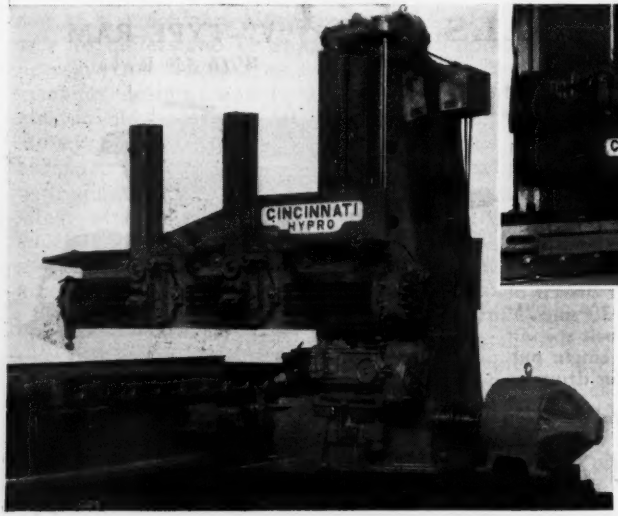
Cincinnati 96-in. Special Openside Planer

The accompanying illustrations show a special openside planer which was designed and built by the Cincinnati Planer Co., 222 South Street, Cincinnati, Ohio, for machining safe doors and frames. The design of the tool-holding mechanism is unique in that two slides of the boring mill type of construction are employed, making it possible to obtain a reach of 40 inches below the bottom of the rail. In addition to the usual clapper box and tool block, provision is made for clamping a bar through a hole in the bottom of the slide so that a bar can be inserted on which a tool can be mounted.

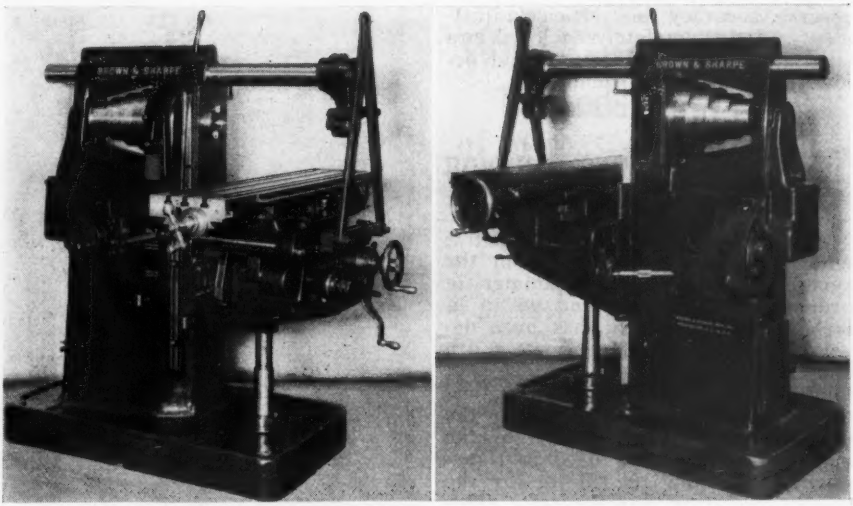
In addition to the regular rail, an extra guide is provided to give additional support to the saddle, the saddle riding on this third way by means of a roller bearing. The harp which carries the slides is bolted to the saddle in the usual manner and, in addition, an extra slot is provided in the top of each saddle to which the head can be bolted, thus giving it additional support. Rack teeth are cut in the harp and a pinion, which is located on the saddle, enables the operator to swivel the head with ease and safety.

A self-contained counterbalance offsets the weight of the slides. The standard feed and rapid traverse is supplied to the heads, and the hand feed is operated through a special square placed at the top of the slide so that the operator can adjust the tool. A supplementary rolling table is supplied so that when machining parts up to 10 feet square, the extreme overhang will be properly supported.

In place of the usual mechanical device for clamping the rail, this



(Left)—Cincinnati 96-in. Special Openside Planer from Operating Position. Note Boring Mill-Type Slides. (Above)—Rear View of Rail, Showing Supplementary Table, Also Built-In Motor for Clamping Rail.



B. & S. No. 2 Std. Universal and Std. Plain Milling Machines

function is performed by a Torque motor which is built into the machine. A safety device makes it impossible to raise or lower the rail while it is clamped. All movements of the machine can be controlled from either side by means of push buttons, one set of buttons being located on a pendant at the end of the rail.

B. & S. No. 2 Std. Universal and Plain Milling Machines

The Brown & Sharpe Mfg. Co., of Providence, R. I., has recently broadened its line of "Standard" Milling Machines by the addition of the No. 2 Standard Universal and No. 2 Standard Plain Milling Machines.

The machines are of the cone drive type and as such are particularly valuable for toolroom installation and for light manufacturing. In addition, they include those advantages and features of the standard machines which have proven so satisfactory for both production and toolroom work.

Power is furnished the machines through cone pulleys mounted on sleeves on the machine spindles. A fast and a slow series of spindle speeds are available with the slow series obtained through back gears easily engaged by a lever on the left-hand side of the machine.

Two operating positions are provided (one at the front and one at the rear of the table) with all levers controlling the operation of the machine readily available from either position. All changes in the power feed of the table are made by rotating either of the feed change levers, which are conveniently located at the front-of-table and rear-of-table operating positions. The rate of feed engaged is shown on both of the direct reading dials, which are set at an angle to facilitate quick reading and are provided with glass windows to prevent clogging by chips and dirt.

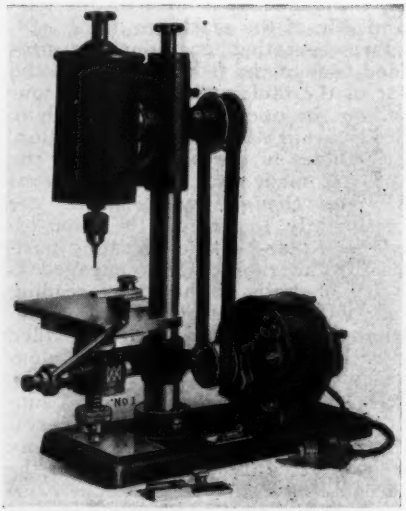
Filtered oil is automatically supplied to all bearings within the column by a plunger pump, thus assuring positive lubrication. A gauge on the side of the column indicates the pressure. Another pump automatically lubricates the knee mechanism, while a large well at the front of the saddle oils the complete saddle mechanism and the table bearings.

The one piece knee elevating screw

assures accuracy in vertical adjustments. It is completely enclosed in a steel sleeve and does not extend below the base of the machine.

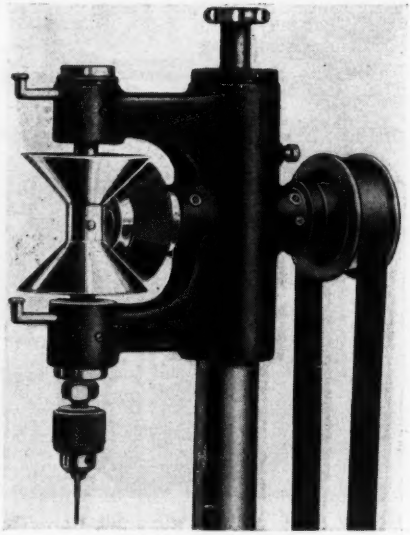
"A. M." Sensitive Tapping Machine

A tapping machine that is sensitive enough for use with taps from the smallest up to $\frac{1}{16}$-inch diameter in ordinary steel or iron and up to ¼ inch in softer material, has been developed by Adolph Muehlmatt, Fifth and Elm Street, S. E., Cincinnati, Ohio. The machine is of the vertical type and is self-contained with the motor mounted on the base of the machine, a belt being used to transmit power from the motor to the spindle-operating mechanism. This mechanism is distinctly different from any other tap-driving mechanism now in use and enables the operator to apply any amount of power required.



"A. M." Sensitive Tapping Machine

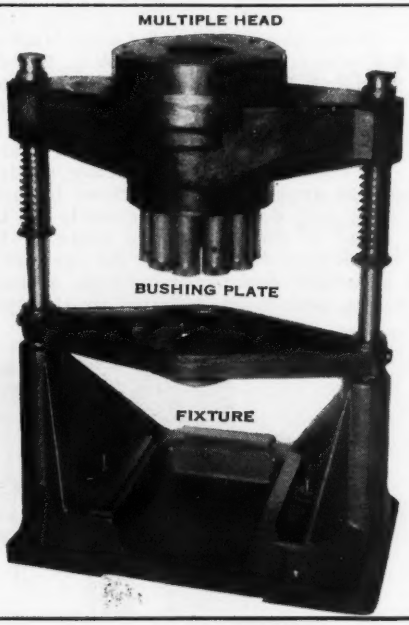
It is also so well-balanced and sensitive that it will drive the smallest taps with less danger of breakage than is generally encountered in tapping by hand.



Spindle-driving mechanism of "A. M." Tapping Machine.

The driving mechanism consists of a leather cone which, in action, contacts with one of the two faces of a double cone on the spindle. Just enough clearance is provided so that the driving cone cannot touch both driven cones at the same time, and the spindle has about $\frac{1}{16}$-inch play vertically which is enough so that all the pressure necessary can be brought to bear to drive the tap. When idling or reversing, the upper driven cone rest on the driving cone and the spindle is reversed by gravity. As the tapping operation is started, the pressure on the point of the tap raises the spindle so that the upper cone is disengaged and the lower one engaged, the amount of power applied to the tap depending upon the pressure exerted on the lever by the operator. When the operation is completed, releasing the pressure on the work allows the spindle to drop so that the upper cone rests on the driver, thus reversing the spindle and withdrawing the tap from the work.

The work is fed to the tap by a



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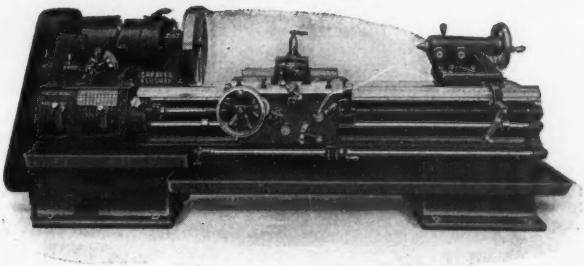


Flexible Motor Drive

1—Centralized Control — operator can change speeds from operating position.

2—Instant Selection of Spindle Speed—no time lost hunting for the right levers to shift.

3—Concentration on the Work—with consequent finer accuracy and higher quality.

4—Increased Production—as a result of the advantages enumerated above.

5—Maintenance of Production Schedules—the simplicity of the speed control enables a new man to produce on a par with an old hand.

6—Long Service—simplicity of design and operation provides for less maintenance and longer life.

Full description in the G-K catalog. Ask for copy.

THE GREAVES-KLUSMAN TOOL CO., Cincinnati, O.

vertical movement of the table, which is mounted on a shaft that slides vertically through a bearing in the supporting arm. The shaft has a rack cut in one side to mesh with a pinion on the levershaft, providing for the vertical movement by which the work is fed to the tap. The shaft is also keyed to the bearing so that it cannot turn. A stop is provided in the form of a split sleeve on which are threaded two knurled nuts, the stop being located on the shaft beneath the table. The stop is adjusted to approximately the desired position, then the nuts are adjusted to the final position, one nut acting as a lock-nut for the other. The lever by which the table is raised and lowered operates crosswise, avoiding the necessity of reaching for it. This lever operates the pinion shaft through a universal ratchet, making it possible to adjust the lever to any desired position immediately.

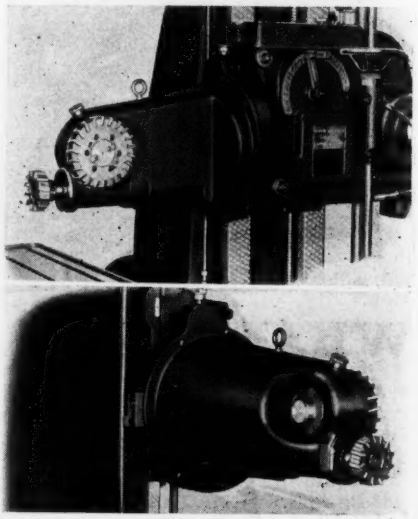
Both the horizontal driving-cone shaft and the vertical double-cone shaft revolve in bronze bushings, each of which is fitted with an oil washer and retaining ring. The horizontal shaft is also provided with thrust ball bearings. The head is adjustable to allow for taking up the belt, or to allow for changing the pulleys. Any desired speed can be secured by the use of extra pulleys.

The base measures 7 x 16 inches; the overall height is 22 inches, and the complete machine weighs 60 pounds. A 4-inch round table for work that can be held by hand and an 8 x 4½-inch square table for jig work are standard equipment. A guard keeps all dirt and dust out of the driving mechanism and prevents possibility of oil-throwing.

G & L Combination Side and End Milling Head for Horizontal Boring Machine

In order to add to the versatility of the No. 45 and 50 Giddings & Lewis High Power Precision Horizontal Boring, Drilling and Milling machines, the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., has developed the combination side and end milling head shown in the illustrations.

The unit is rigidly built with a body of cone shape and of heavy section. It is applied to the machine by bolting and dowelling it directly to the head of the machine in place of the back gear cover plate. An eye-bolt is provided for handling with a hoist. The cutters are actuated by the spindle of the machine, an arbor carrying a gear being placed in the spindle, where it meshes with a gear on the end of a worm shaft, to which the small milling cutter is attached. The large cutter is driven from the small cutter shaft through a hardened and ground alloy steel worm and bronze worm wheel. The speed of the large cutter is one-fourth the speed of the small cutter, which is the same as the spindle speed.



(Above)—G. & L. Combination Side and End Milling Head for Horizontal Boring Machines. (Below)—Rear View of Head.

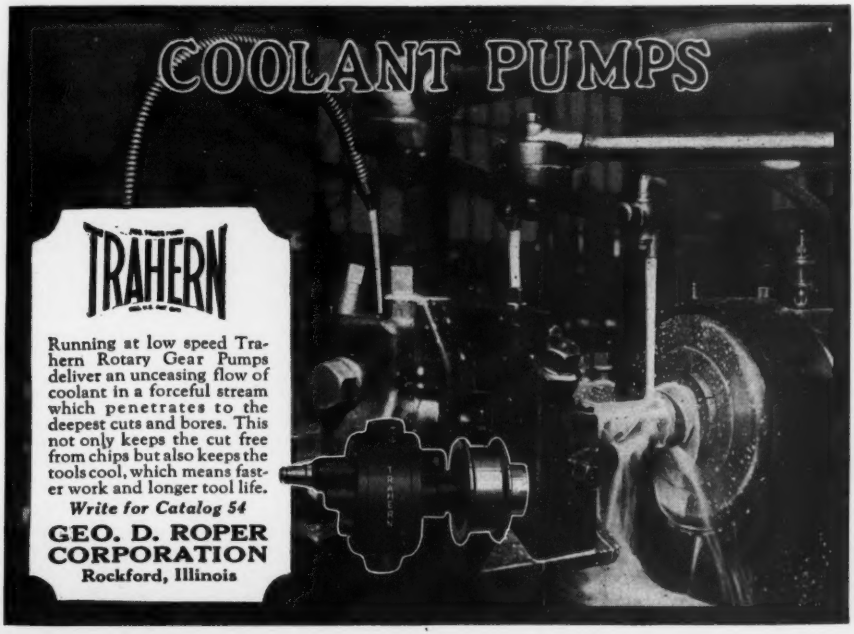
All bearings are heavy type combination radial and thrust ball bear-

In the Interest of Better Broach Performance—

AN INSTRUCTIVE CHART on "How to Properly Grind Broaches" is ready for free distribution to broach users. Used as a guide, this "Red Ring" Chart will assure maximum broach life and performance. These grinding instructions are, of course, applicable to the grinding of all makes of broaches. Upon request these charts will be mailed to you, without cost or obligation, for display in your grinding department. Please specify the number required.

The NATIONAL BROACH CO.

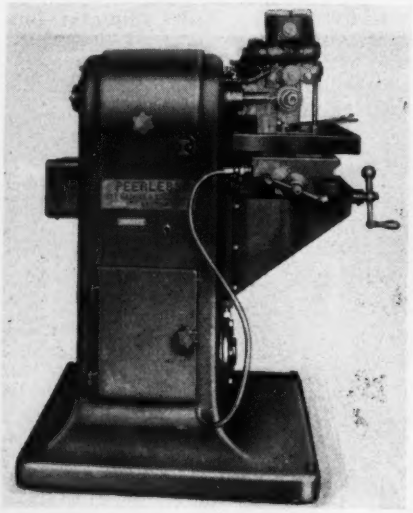
5 N. JUNE STREET DAYTON, OHIO


COOLANT PUMPS
TRAHERN
Running at low speed Trahern Rotary Gear Pumps deliver an unceasing flow of coolant in a forceful stream which penetrates to the deepest cuts and bores. This not only keeps the cut free from chips but also keeps the tools cool, which means faster work and longer tool life.
Write for Catalog 54
GEO. D. ROPER CORPORATION
Rockford, Illinois

ings, which, together with the worm and wheel, are packed in grease and completely enclosed. A draw bolt, accessible through the hand hole, is used to draw the small milling cutter arbor into the socket. The head can be furnished in two sizes with single or double mills, to fit either the No. 45 or No. 50 G. & L. machines. A similar attachment with a large milling cutter can be furnished for vertical milling.

Peerless Gear Tooth Chamfering Machine

Any shape required on a gear tooth can be produced with the Peerless Chamfering Machine, which is built by the City Machine & Tool Works, 1521 East Third Street, Dayton, Ohio. The machine is designed and built for long service on continuous production, and will chamfer both internal and external teeth. The spindle is mounted in Timken Tapered Roller Bearings, providing for continuous, smooth, chatterless operation. The spindle operates at a speed of 1,600 r. p. m. for all ordinary work. Power is supplied through a 1½ h. p. motor, located in the base of the machine. A Brown & Sharpe No. 1 geared pump keeps the work and cutter flooded with lubricant. The operation of the machine is entirely automatic, requiring the attention of an operator only to change the work. Thus one operator can operate two machines where necessary.



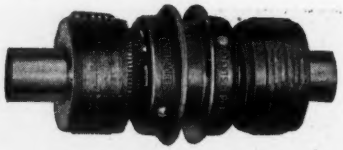
Peerless Gear Tooth Chamfering Machine

The machine is 49½ inches high by 36 inches long and 25 inches wide. Weight, net, 1,800 pounds.

Pullmore Industrial Clutch

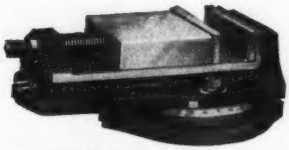
A clutch of the multiple disc type, intended for industrial purposes, has been placed on the market by the Rockford Drilling Machine Company, Rockford, Ill. The clutch is the Pullmore Industrial Clutch, illustrated herewith.

The unit shown is the No. 3 Double Clutch, the mechanism of which runs in an oil bath. It measures 3½ inches diameter by 5.812 inches long, being compact, adaptable, and easy to adjust. The capacity of the unit is 5 h. p. at 500 r. p. m. It can also be adapted to run dry, if desired. All parts of the oil-type clutch are of high-grade steel, hardened and ground. The outer discs of the dry type are of high-grade bronze, impregnated with graphite. The perfect balance of the Pullmore clutch permits its operation at high speeds, and it is not affected by centrifugal force. The clutch is made in six standard sizes, single or double, of from 2 to 25 h. p. at 500 r. p. m., for installation on ⅞-inch to 2¼-inch shafts. Variations in ratings according to r. p. m.



Pullmore Industrial Clutch

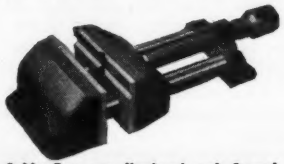
Sheldon Milling Machine Vises



Furnished Both Plain and With Swivel Base.
SPECIFICATIONS AND PRICES:

No.	Width of Jaws	Depth of Jaws	Jaws Open	PLAIN VISE Wt., lbs.	PLAIN VISE Price	SWIVEL VISE Wt., lbs.	SWIVEL VISE Price
3	3½"	1⅜"	2½"	15	$16.00	25	$20.00
4	4½"	1⅝"	3½"	30	$20.00	45	$24.00
6	6½"	2 "	4½"	70	$30.00	90	$40.00
8	8½"	2½"	7 "	160	$45.00	225	$60.00

Sheldon Drill Press Vises



Guide Bars are Hardened and Ground.
SPECIFICATIONS AND PRICES:

No.	Width of Jaws	Depth of Jaws over Guide Bars	Full Depth of Jaws	Jaws Open	Wt., lbs.	Price
D 4	4½"	1⅝"	3"	4"	15	$12.00
D 6	6½"	1¾"	3½"	6"	35	$18.00
D 9	9 "	2½"	4½"	9"	70	$24.00

Sheldon Shaper Vises

SPECIFICATIONS AND PRICES:

No.	Size of Jaws	Vise Opens	Bolt Hole Spacing*	Wt., lbs.	Price
1	12" x 2½"	12½"	7½"	175	$120.00
2	14" x 2¾"	13½"	8½"	240	$135.00

*Distance between holes can be changed without additional charge.

Write for Catalog Describing Full Line of SHELDON Tools For the Machine Shop.

SHELDON MACHINE Co.
3251 Cottage Grove Avenue CHICAGO, ILL.

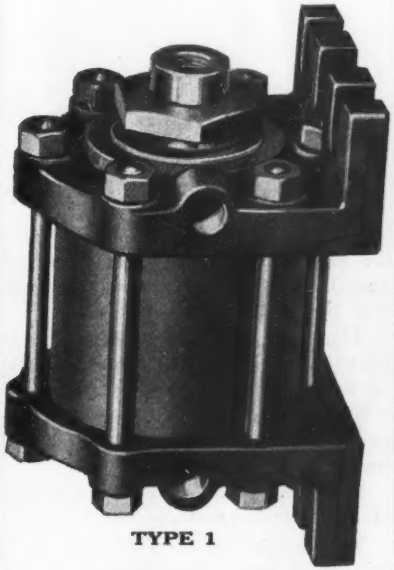
"HOPKINS" PREFERRED EQUIPMENT

Non-Rotating
Double-Acting
Air Cylinders!

Another "HOPKINS" achievement. This illustrates only one of several of our "HOPKINS" Tubular Type Cylinders.

They are available in any diameter or length.

Send for Catalog and Complete Engineering Data.



TYPE 1

Send for Catalog

THE TOMKINS-JOHNSON CO.
620 MECHANIC STREET
JACKSON, MICH., U.S.A.

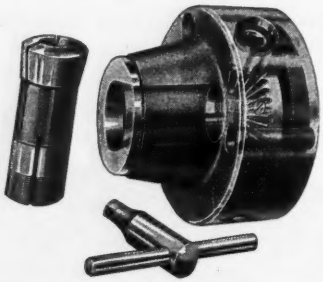
Also Manufacturers of Chucks, Die Sinking Milling Cutters, Work Stands, Special Equipment, Etc.

Any bar that will pass through the lathe spindle can be held in this

New

Cushman Nose Type COLLET CHUCK

if it is not over 1¾ inches in size.



The chuck offers no obstruction to the hole and is mounted on the spindle nose by bolting to a plate in the same way that a lathe chuck would be.

The body is a solid piece of steel, heat-treated and ground perfectly true on both outer and inner surfaces.

Two ground bearings in the collet provide for accuracy in holding the work.

Discs and pinions are of a fine grade of alloy steel, carefully heat-treated.

The special type collets can be obtained in sizes from ½-inch to 1¾-inch, inclusive, from us or from any distributor.

Ask for details and prices!

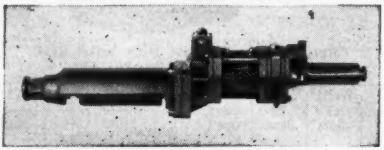
THE CUSHMAN CHUCK CO.

805 Windsor Street

HARTFORD CONN.

Thor Locomotive Rod Grinder

The Independent Pneumatic Tool Company, 236 South Jefferson Street, Chicago, Ill., manufacturer of "Thor" pneumatic and electric tools, has



Thor Locomotive Rod Grinder

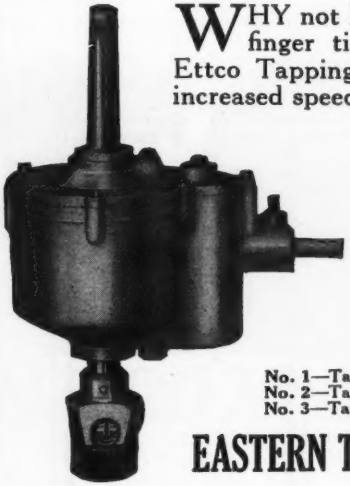
placed on the market a rod grinder which is especially adapted for locomotive work. The tool is unusually strong and powerful, and is intended for use in surfacing locomotive frame jaws, rods, straps, rod brasses, shoes and wedges, welds, and valve motion parts. The wheel guard is made small enough in diameter to get into a 2¾-inch space.

The Thor rod grinder is available in two lengths of wheel—6-inch and 9-inch. The 6-inch size operates at a speed of 7,000 r. p. m., weighs 21½ pounds, and is 26 inches long. The wheel used with this tool is 6 inches long, 2½ inches in diameter, and with a ¾-inch hole. The 9-inch size also runs at a speed of 7,000 r. p. m., weighs 23¾ pounds, and is 29 inches long. This size takes a 9-inch emery wheel, 2½ inches in diameter and with a ¾-inch hole.

Federal Model "80" Junior Dial Indicator

The Federal Products Corporation, Providence, R. I., has brought out a dial indicator which is similar in construction to the Model 80, also made by this firm, but which is much smaller in diameter. The diameter of the indicator is 1 23-32 inch, and the holding bar is 2⅜ inches long by ¼ inch in diameter. Special sizes of

IF YOU TAP HOLES—



WHY not have the feel of the tap right at your finger tips? A tap is a delicate tool. The Ettco Tapping Attachment taps delicately—with increased speed—That's the answer.

The ETTCO Tapping Attachment

is simple—nothing to adjust—if the tap sticks or hits bottom, the Ettco slips—the same action coming out. No clash of a positive clutch—just the smooth action of the patented leather lined cone clutch.

Sensitive :: Speedy :: Satisfactory

No. 1—Tapping Attachment, 3-16" in steel, ¼" in C. I....$35.00
No. 2—Tapping Attachment, 5-16" in steel, ⅜" in C. I.... 50.00
No. 3—Tapping Attachment, ½" in steel, ⅝" in C. I.... 80.00

EASTERN TUBE & TOOL CO., Inc. 596 Johnson Ave BROOKLYN, N.Y.

Now an *Improved*

Rapid Clamp!

Drop-Forged Steel

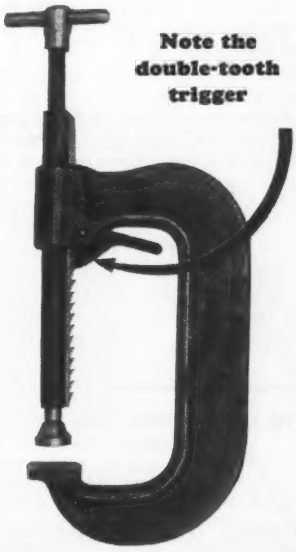
THE new double-tooth trigger gives the tool added strength and power. Will withstand the hardest usage.

No time wasted turning the screw. Pull the trigger, set the ram up to the work, then give the screw a turn to obtain the necessary pressure. Unequaled for

Speed :: Power :: Rigidity

Made in 6" and 8" sizes. New light 4" clamp ready for delivery soon.

Quality throughout. Every clamp warranteed



Note the double-tooth trigger

Fountain Equipment & Mfg. Co.
2025 Elm Street Cincinnati, Ohio

The

"Rite-Speed" Grinder

cuts costs as much as 50 per cent

WHEN the Rockford Northwestern Malleable Corp., of Rockford, Ill., installed a model 173 "Rite-Speed" Grinder they expected to save money.

And a check-up showed savings far beyond their expectations. The "Rite-Speed" Grinder, with two 30 x 3 Safe-T-Bond Grinding Wheels operating at a peripheral speed of 9,000 feet per minute, saved as much as 50 per cent on some jobs.

Such savings are by no means unusual. For the Safety "Rite-Speed" Grinder is *fast, safe* and *fool-proof*. It will pay for itself through savings in abrasive wheels *alone* because it *automatically* enforces the proper operating speed. Mail the coupon today for complete information about this "nearly human" grinder.

TRADE MARK SAFETY

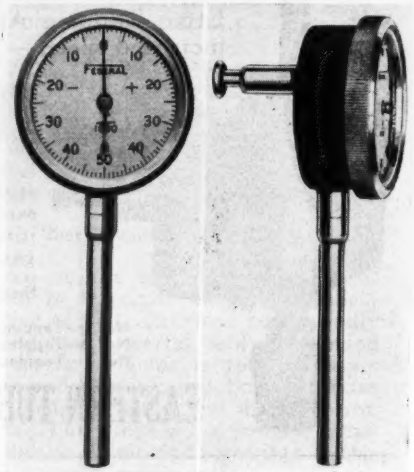
THE SAFETY GRINDING WHEEL & MACHINE CO.
2354 Columbus Ave., Springfield, O.
Please send me bulletin F-28-3 regarding your "Rite-Speed" Grinders.

(Name of Individual)

Pin this to your letterhead

holding bars can be furnished if desired.

The tool can be furnished with or without jewel bearing movement as desired. The racks are chromium-plated and the movement is a separate unit, assuring perfect alignment. The stem is cast integral with the case, and the entire movement can be removed for repairing in less than two minutes. The range of the indicator is .200 inch and the dial can be furnished graduated either 0-50-0 or 0-100.



Federal Model "80" Jr. Dial Indicator

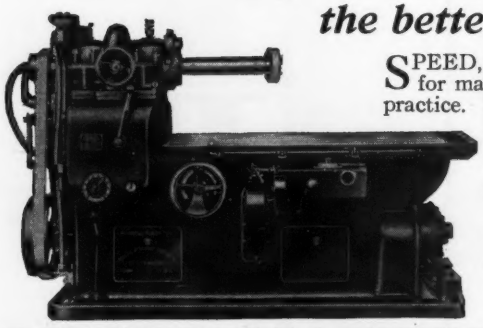
"Hisey" Foot Treadle Switch for Grinders

The illustration shows the convenient type of foot treadle switch which is now being furnished by The Hisey-Wolf Machine Co., Cincinnati, Ohio, for use on Hisey motor-driven grinding and buffing machines. The treadle acts as a switch upon being forced down by the weight of the operator's foot, rising again and automatically shutting off the current when the foot is removed. It extends the entire width of the column, allowing simultaneous operation by two workmen

(Continued on page 80)

GRINDERS MICRO

By all Tests—
the better Grinding Method



SPEED, Accuracy and Economy are essential for maximum efficiency in modern grinding practice. Embodied in the design of MICRO Internal Grinders are many exclusive features that make possible the realization of these performance qualities to a most amazing degree.

For that internal grinding job, there's a MICRO to do it *quicker—better—cheaper.*

Write for complete descriptive details.

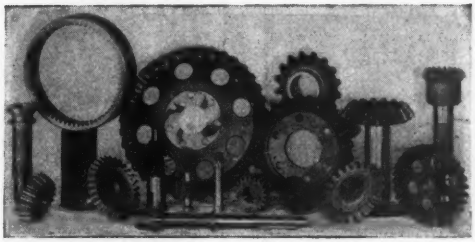
MICRO MACHINE COMPANY

Bettendorf — MANUFACTURERS AND DESIGNERS OF *PRECISION GRINDERS* FOR ALL PURPOSES — Iowa, U-S-A

Spur - Spiral - Bevel - Worm

Cut Gears—Any Quantity—Any Material

From Blue Prints or Specifications Demanding Close Tolerance

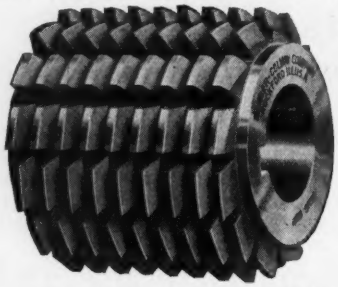


We Specialize in Aircraft and Other Precision Gears

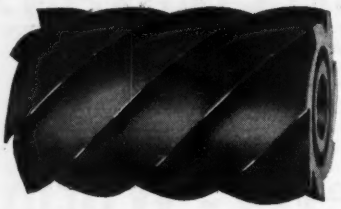
STEEL PRODUCTS ENGINEERING CO.

1160 WEST MAIN STREET — **SPRINGFIELD, OHIO**

SERVICE *Is Our Motto* QUALITY *Our Creed*



GEAR HOBS
and
"BETTER CUTTERS"

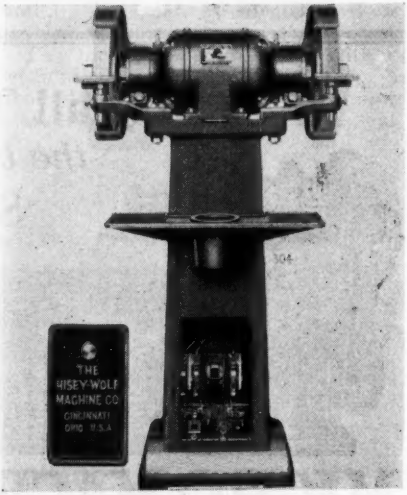


by
BARBER-COLMAN
of
ROCKFORD

THESE Small Tools are built for long hours of steady use... to stand the battering of a heavy feed and emerge triumphant... to hew steadily to the limit line beneath a chattering mountain of chips... Quality to the core... strength and sturdiness ever dependable.

BARBER-COLMAN COMPANY

General Offices and Plant—Rockford, Ill., U. S. A.



"Hisey" Foot Treadle Switch for Grinders

without hindering or interfering with each other. The switch eliminates waste of current and saves time.

BROACH *for*
Accuracy—Economy!

Let us show you how to finish more holes—more accurately—and at less cost.

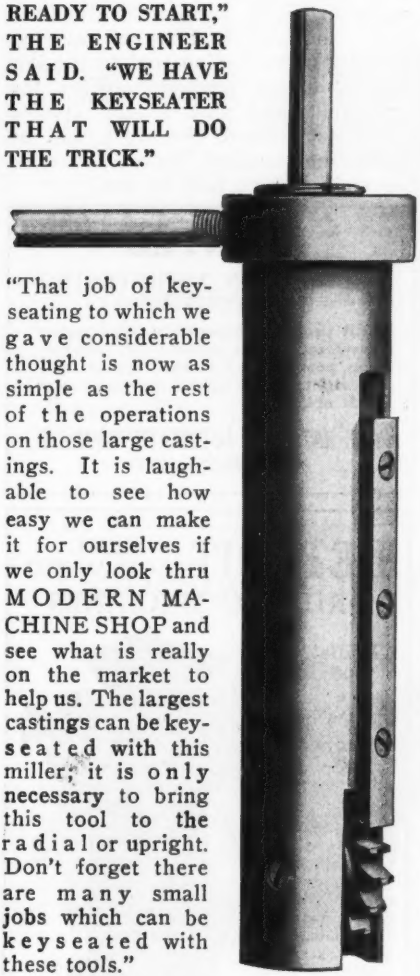
The American 2-Ton Hydraulic Press

is recommended for broaching connecting rods and work that comes within the 2-ton range. We manufacture presses from 2 tons to 150 tons pressure, also all types of broaching tools.

AMERICAN BROACH & MACHINE CO.
ANN ARBOR, MICHIGAN

"ALL SET

READY TO START," THE ENGINEER SAID. "WE HAVE THE KEYSEATER THAT WILL DO THE TRICK."



"That job of keyseating to which we gave considerable thought is now as simple as the rest of the operations on those large castings. It is laughable to see how easy we can make it for ourselves if we only look thru MODERN MACHINE SHOP and see what is really on the market to help us. The largest castings can be keyseated with this miller; it is only necessary to bring this tool to the radial or upright. Don't forget there are many small jobs which can be keyseated with these tools."

Get Catalog "Q"

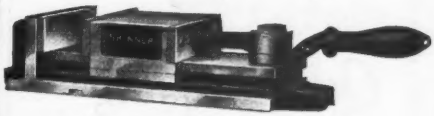
National Machine Tool Co.

2271 Spring Grove Avenue

CINCINNATI, OHIO, U. S. A.

SKINNER DUAL ACTION MILLING MACHINE VISES

LEVER TYPE



Plain Vise

HAS A GRIP OF 40 TO 1

THE SKINNER VISE, Dual Action, for Milling and Drilling Machines, combines the range and conveniences of the screw with the quick action of the cam. Rotating the knurled collar on the screw provides the major adjustment, while moving the handle either side towards the center closes the jaws with a powerful grip.

Swivel Vise

Size No.	List Price Plain Vise	Size No.	List Price Swivel Vise	Weight Boxed Lbs. Vise	Vise and Swivel
4-DA	$37.00	4-DS	$52.00	22	30
5-DA	42.00	5-DS	57.00	35	40
6-DA	62.00	6-DS	67.00	45	54

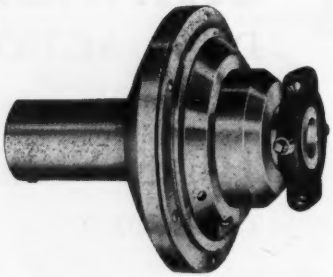
THE SKINNER CHUCK COMPANY

NEW BRITAIN, CONN U.S.A

(Continued from page 64)

taken as the breaking-down point of the leading tool.

Though interesting in itself, this test suggests a method of producing duplicate work within the required limits, and without frequent gauging. By setting the leading tool to the low limit, and the trailing tool to the high limit, and with a stop applied to the cross feed, the work will be within the required limits as long as the trailing tool fails to cut.



Quit Trifling—

with the most important function of production.

The ***Conway Disc*** is the last word in friction clutches. Install one and the control of your machines is no longer a problem.

You are only temporizing with starting and stopping until you adopt the efficient command of the Conway Disc Clutch.

The Conway Clutch Co.
1959 W. 6th St., Cincinnati, Ohio

"It is a splendid Clutch."

WANTED
PRODUCTION ENGINEERING EXECUTIVE

with practical experience, thoroughly conversant with present-day production problems. Unusual opportunity for right man. Salary commensurate with ability.

THE NATIONAL AUTOMATIC TOOL CO.
RICHMOND, IND.

DETROIT SEMI-AUTOMATIC DRILLING MACHINES

Drills 900 to 1200 holes per hour.

Capacity—No. 60 to 3/8-in. Drills. Standard Fixtures will handle round or hex. stock. Five spindles, cam control. Unsurpassed for speed, accuracy and low cost operation. Over 1800 in successful operation.

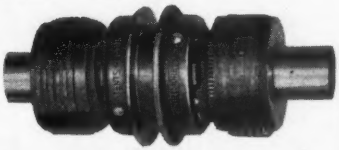
DETROIT MACHINE TOOL CO.
5055 Woodward Ave., Detroit, Mich.

TO SOLVE YOUR CLUTCH PROBLEMS

MAIL THIS TO:

ROCKFORD DRILLING MACHINE CO.,
ROCKFORD, ILLINOIS

IF THIS



NEW

[DOUBLE type illustrated.
SINGLE type also furnished.
Furnished to run in oil or dry.]

PULLMORE Industrial Clutch

MAKES POSSIBLE:
- Extreme Compactness
- Greater Clutch Efficiency
- Fewer Adjustments
- Ready Adaptability

MAIL US DETAILS

Name .....

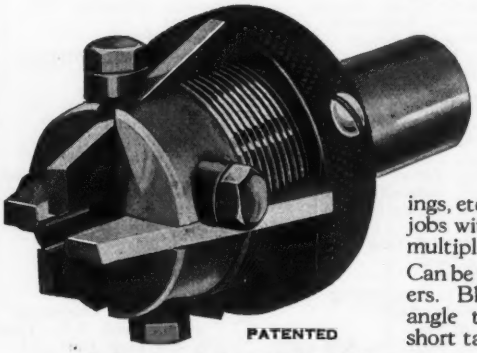
Firm .....

Address .....

CUT HERE

Genesee Adjustable Hollow Mill

Made in 7 different styles



PATENTED

Has adjustable, replaceable blades and can be replaced at nominal cost, making it unnecessary to continually buy new tools.

The ideal tool for finishing your forgings, castings, etc. Do your several operation jobs with Genesee inserted blades multiple operation tools.

Can be fitted with drills and reamers. Blades can be ground any angle to point work and turn short tapers.

A Genesee Adjustable Hollow Mill can be made for every job

WRITE FOR CATALOGUE

GENESEE MANUFACTURING CO., Inc.

ROCHESTER, NEW YORK

Check For Information Wanted

If you are interested in prices or information on any of the equipment listed, check the item, write your name, firm name, title and address on the margin, tear out the page and send it to Modern Machine Shop, 128 Opera Place, Cincinnati, Ohio. We will see that you are supplied with the information desired.

- ☐ Abrasive Discs
- ☐ Abrasive Polishing Grains
- ☐ Arbors
- ☐ Babbitt Metal
- ☐ Balancing Machines
- ☐ Balancing Ways
- ☐ Bearings, Ball or Roller
- ☐ Bearings, Die-cast
- ☐ Bearings, Bronze & Bab't
- ☐ Belting, Leather
- ☐ Belt Dressing
- ☐ Bench Legs
- ☐ Benches
- ☐ Bending Machines
- ☐ Blue Printing Machinery
- ☐ Bolt and Nut Machinery
- ☐ Bolts and Nuts
- ☐ Bolts, Stripper
- ☐ Boring Bars
- ☐ Boring Mills, Vertical
- ☐ Boring Mills, Horizontal
- ☐ Boring Heads
- ☐ Boring Tools
- ☐ Broaches
- ☐ Broaching Machines
- ☐ Bushings, Jig
- ☐ Bushings, Bearing
- ☐ Cabinets, Steel, Shop
- ☐ Calipers
- ☐ Centering Machines
- ☐ Centers, Lathe
- ☐ Chains, Sprocket
- ☐ Chamfering Machines
- ☐ Chucking Machines
- ☐ Chucks, Air-Operated
- ☐ Chucks, Quick-Changing
- ☐ Chucks, Collet
- ☐ Chucks, Drill and Tap
- ☐ Chucks, Lathe and Planer
- ☐ Clamps, Machinists'
- ☐ Clutches, Friction
- ☐ Collars, Spacing
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- ☐ Compressors, Air and Gas
- ☐ Contract Work
- ☐ Counterbores
- ☐ Countersinks
- ☐ Couplings, Flexible
- ☐ Cutters, Gear
- ☐ Cutters, Keyseating
- ☐ Cutters, Milling
- ☐ Cutting-Off Machines
- ☐ Cutting-Off Tools
- ☐ Dies, Self-Opening
- ☐ Dies, Threading
- ☐ Die Sets
- ☐ Die Shoes
- ☐ Dividing Heads
- ☐ Dogs, Lathe
- ☐ Dowel Pins
- ☐ Dressers, Grinding Wheel
- ☐ Drill Holders
- ☐ Drilling Machines, Bench
- ☐ Drilling Machines, Sensitive
- ☐ Drilling Machine Heads
- ☐ Drilling Mach., Automatic
- ☐ Drilling Machines, Gang
- ☐ Drilling Mach., Heavy Duty
- ☐ Drilling Machines, Multiple
- ☐ Drilling Machines, Radial
- ☐ Drills, Center
- ☐ Drills, Portable Electric
- ☐ Drills, Portable Pneumatic
- ☐ Drills, Ratchet
- ☐ Drills, Twist and Flat
- ☐ Files and Rasps
- ☐ Filing Machines
- ☐ Forging Machinery
- ☐ Furnaces, Forging
- ☐ Furnaces, Heat Treating
- ☐ Furniture, Machine Shop
- ☐ Gauge Blocks
- ☐ Gauges, Dial
- ☐ Gauges, Plug and Ring
- ☐ Gauges, Thread
- ☐ Gear Blanks, Composition
- ☐ Gear-Cutting Machinery
- ☐ Gears, Cast or Cut
- ☐ Grinding Mach., Cylindrical
- ☐ Grinding Machines, Univ.
- ☐ Grinding Machines, Cutter
- ☐ Grinding Machines, Drill
- ☐ Grinding Machines, Internal
- ☐ Grinding Machines, Portable
- ☐ Grinding Machines, Surface
- ☐ Grinding Wheels
- ☐ Grinding Wheel Stands
- ☐ Hammers, Pneumatic
- ☐ Hobbing Machines
- ☐ Hobs, Gear
- ☐ Hoists, Chain or Electric
- ☐ Indicators, Speed or Test
- ☐ Jacks, Planer
- ☐ Keyseating Machinery
- ☐ Lapping Machines
- ☐ Lathes, Engine
- ☐ Lathes, Turret
- ☐ Lathes, Automatic
- ☐ Lathes, Bench
- ☐ Lathes, Gap
- ☐ Lathes, Polishing
- ☐ Lathe Dogs
- ☐ Lubricants
- ☐ Mandrels, Expanding
- ☐ Mandrels, Solid
- ☐ Micrometers
- ☐ Milling Machines, Automatic
- ☐ Milling Machines, Bench
- ☐ Milling Machines, Horizontal
- ☐ Milling Machines, Vertical
- ☐ Milling Attachments
- ☐ Milling Tools
- ☐ Oil-Grooving Machines
- ☐ Oil Stones
- ☐ Oils
- ☐ Ovens, Industrial
- ☐ Parallels
- ☐ Pipe-Cut'g & Th'd'g Mach'y
- ☐ Pipe Tools
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- ☐ Presses, Arbor
- ☐ Presses, Punch
- ☐ Pulleys, Metal or Wood
- ☐ Pumps, Lubricant or Oil
- ☐ Punches, Hand
- ☐ Punches, Power
- ☐ Punch Holders
- ☐ Racks, Cut
- ☐ Reamer Holders
- ☐ Reamers, Adjustable
- ☐ Reamers, Solid
- ☐ Riveting Machines
- ☐ Rules, Steel and Wood
- ☐ Rust Preventatives
- ☐ Saws, Metal
- ☐ Saw Frames and Blades
- ☐ Sawing Machines, Power
- ☐ Saws, Band
- ☐ Saws, Milling
- ☐ Scales, Machinists'
- ☐ Screw Machines, Automatic
- ☐ Screw Machines, Hand
- ☐ Screws, Cap, Set or Mach.
- ☐ Shafting
- ☐ Shafts, Flexible
- ☐ Shapers
- ☐ Shears, Hand or Power
- ☐ Sleeves, Drill
- ☐ Springs, Pressure Pad
- ☐ Squares
- ☐ Stamps, Steel
- ☐ Stands, Shop, Portable
- ☐ Tap Holders
- ☐ Tapes, Measuring
- ☐ Tapping Machines
- ☐ Tapping Attachments
- ☐ Taps and Dies
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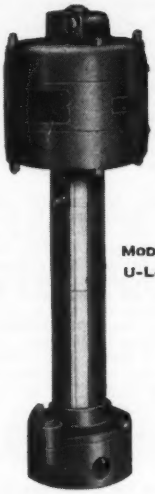

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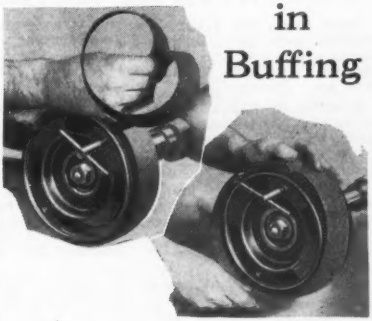

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Turret Lathes and Tools: Illustrated book describing Cincinnati Acme Turret Lathes and Screw Machines, and showing a variety of tools and fixtures for use with these machines. The Acme Machine Tool Co., 4955 Spring Grove Ave. Cincinnati, Ohio.

Broaching By Modern Methods: Equipment and tools for finishing round, square or irregular-shaped holes and surfaces by broaching are described and illustrated in a booklet that is issued free by the American Broach & Machine Co., Ann Arbor, Michigan.

Scraping By Power. Bearing surfaces can now be scraped with a power scraper that is quicker and easier than the old-fashioned hand method. The tool is described in a folder that is issued by Anderson Bros. Mfg. Co., 1926 Kishwaukee St., Rockford, Ill. Sent free on request.

Steel Furniture for the Shop: The complete line of steel furniture made by the Angle Steel Stool Co., Plainwell, Michigan, including steel stools and chairs, steel foremen's desks, lockers, tables, tool stands, machine tenders, shop boxes and pans, iron bar racks, trucks, bench legs, and bench drawers, is described and illustrated in Catalog "C," which is issued free to machine shop executives.

Stop Tap Breakage: A booklet that tells how to stop the breakage of taps, reamers, and other tools, by the use of a friction chuck, also how to use the chuck for setting studs or nuts, has been issued by The Apex Machine Co., 200 Davis Ave., Dayton, Ohio. Sent free upon request.

Machine Shop Accessories: Catalog B-27, issued by the Armstrong Bros. Tool Co., 328 N. Francisco Ave., Chicago, Ill., describes the line of tool holders, boring tools, wrenches, pipe tools, ratchet drills, lathe dogs, and other tools manufactured by this company.

Hobs and Milling Cutters: A complete line of milling cutters and hobs for cutting all kinds of gears, splines, sprockets and other forms is described in Catalog G, issued by the Barber-Colman Company, Rockford, Ill. Descriptions and illustrations of the Barber-Colman hobbing machine and hob-sharpening machines are included. Sent free on request.

All-Geared Drilling and Tapping Machines: A catalog describing in detail the various types of all-geared, self-oiling, drilling and tapping machines made by the Barnes Drill Co., 801-851 Chestnut Street, Rockford, Ill., will be sent free upon request.

Modern Drilling Equipment: Circulars describing the various types and sizes of Barnes upright drills, multiple drills and horizontal drilling machines made by this company have been issued by the W. F. & John Barnes Co., Rockford, Ill.

Automatic Oiled Die Sets: The automatic oiled die sets, die shoes, punch holders, leader pins, bolster plates, bushings, and other standard die parts made by the E. A. Baumbach Manfg. Co., 1806 S. Kilbourn Ave., Chicago, Ill., are described in Catalog No. 5, which has been issued by that company. Sent free upon request.

Bradford Precision Lathes: Precision Lathes for the tool room and for general manufacturing purposes, all-geared and cone types, belt or motor driven, are described and illustrated in a catalog that is issued by The Bradford Machine Tool Co., 657-671 Evans St., Cincinnati, Ohio. The catalog also includes descriptions of taper, relieving, turret and other lathe attachments. Sent free upon request.

How to Sharpen Cutters: A series of leaflets, which describe and illustrate the correct methods to employ in sharpening all kinds of cutters, can be obtained, without charge, by addressing Brown & Sharpe Mfg. Co., Providence, R. I.

Drilling Machinery: Circulars describing all types and sizes of radials, uprights, and gang drills for every class of work may be had by writing to The Cincinnati Bickford Tool Co., Oakwood, Cincinnati, Ohio.

Gear Data: The Cincinnati Gear Co., Cincinnati, Ohio, has published Catalog D, which describes and illustrates the various types and kinds of gears made by this firm. The book contains photographs of the plant departments, with descriptions of the equipment employed, and also includes a number of pages of valuable data and reference tables for machine shop use.

Rapid Traverse Planers: Cincinnati Hypro Planers, made by the Cincinnati Planer Co., Cincinnati, Ohio, are described in a new catalog that has been issued by this company.

Shaper Progress: An illustrated catalog describing the various types of shapers made by the Cincinnati Shaper Co., Cincinnati, Ohio, and including descriptions of Cincinnati Shapers in use in different kinds of plants.

Handbook For Drillers: The Cleveland Twist Drill Co., 1242 E. Forty-ninth St., Cleveland, Ohio, has published a book in which the various parts of the twist drill are described, and which tells how to grind a drill correctly. The troubles that result from incorrect grinding are described and illustrated and several chapters are devoted to the subjects of speeds, feeds, materials, cutting compounds, and so on. Sent free upon request.

Inserted Blade Reamers: A new type of reamer with high speed steel blades, designed to reduce cutting costs and give longer service, is described in a bulletin that will be sent without charge upon application to the Conradson Tool Corporation, 2114 Indiana Ave., Chicago, Ill.

Disc, Expansion and Compression Clutches: The various types of clutches and their uses are discussed in an illustrated booklet that is issued by The Conway Clutch Co., 1959 West Sixth Street, Cincinnati, Ohio.

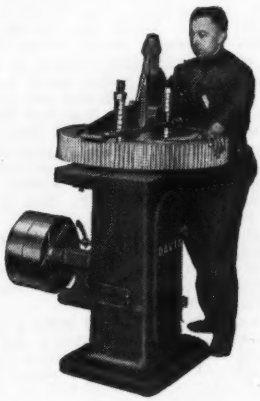
Cushman Chucks: A series of bulletins has been issued by The Cushman Chuck Co., 805 Windsor St., Hartford, Conn., describing the lathe, screw machine, boring mill, drill press and other chucks made by this firm. Sent free upon request.

Die Makers' Supplies: A complete line of die sets, leader pins, bushings, and other die makers' supplies are described in a book that is issued by the Danly Machine Specialties, Inc., 2104 South 52nd Avenue, Chicago, Ill. Sent free upon request.

Davis Keyseaters: Recent developments in keyseating methods are discussed in a bulletin that also describes the keyseaters made by the Davis Keyseater Company, 250 Mill St., Rochester, N. Y. Copy free upon request.

Grinding Wheel Dressers: All of the different types of grinding wheel dressers made by the Desmond-Stephan Mfg. Co., Urbana, Ohio, including Desmond-Huntington, Desmond-Sherman, Zig-Zag, Diamo-Carbo, and diamond dressers, are described and illustrated in a catalog that has been published by the firm mentioned. Free upon request.

Quantity Drilling: A semi-automatic multiple spindle drilling machine which is designed to produce the maximum of drilled holes in medium or small parts, is described in a pamphlet that is published by the Detroit Machine Tool Co., 5055 Woodward Ave., Detroit, Michigan. Sent free upon request.



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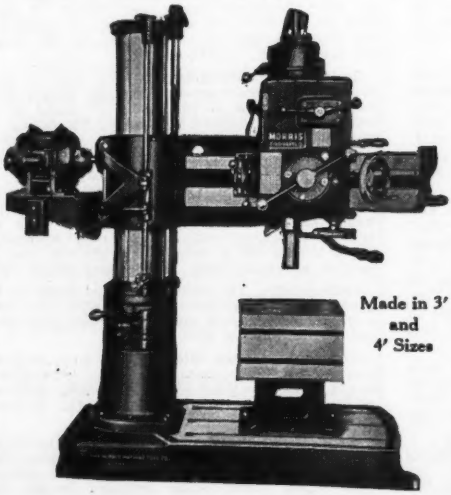

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Interchangeable High Production Tools: Catalog No. 28, issued free by the Eclipse Interchangeable Counterbore Co., 7410 St. Aubin St., Detroit, Michigan, describes and illustrates the interchangeable counterbores, spot facers, end form cutters, and other end cutting tools made by this firm.

Precision Measuring Instruments: The latest types and models of dial indicators, thread lead test gages, pitch gages, thickness gages, dial comparators, and other precision measuring instruments marketed by the Federal Products Corporation, Providence, R. I., are described and illustrated in a book that will be sent free upon application to this firm.

Silent, Self-Lubricating Gears for use in all kinds of machines are described in a booklet that can be had upon application to Fibroc Insulation Company, Valparaiso, Indiana.

Formica Silent Composition Gears: A booklet telling about the uses and advantages of Formica Silent Shock Absorbing Gears, and containing a considerable amount of valuable data with rules and tables for laying out, cutting and using gears. Sent free by Formica Insulation Co., 4632 Spring Grove Avenue, Cincinnati, Ohio.

Fosdick Drills: This publication gives details as to the design and construction of Fosdick Radial, Upright, and Sensitive Drills. Published by the Fosdick Machine Tool Co., Cincinnati, Ohio.

Quick-Acting Clamp: A bulletin describing the "Rapid" drop-forged steel clamp manufactured by the Fountain Equipment & Mfg. Co., 2025 Elm St., Cincinnati, Ohio, has been issued by this firm.

Modern Grinding Equipment: The complete line of universal tool and cutter grinders, surface grinders, drill grinders, tap grinders, and other grinding machines made by the Gallmeyer & Livingston Co., 336 Straight St., S. W., Grand Rapids, Michigan, is described in a series of bulletins that have been issued by this firm. Free upon request.

Saving Time by Disc Grinding: A book that tells how production costs can be reduced by the use of modern disc-grinding equipment, and which describes and illustrates the latest types of machines used for this work, has been issued by the Gardner Machine Company, Beloit, Wis. A number of illustrations of jobs in operation, together with complete production data, are included.

Adjustable Blade Cutters: Hollow mills, facing tools, face mills, milling cutters and other production tools with adjustable, interchangeable blades are described and illustrated in a booklet that is issued free by the Genesee Manufacturing Co., 141 N. Water St., Rochester, N. Y.

Horizontal Boring, Drilling and Milling Machines for production or tool room work are described and illustrated in a series of bulletins that have been issued by Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Copies free upon request.

1500 Good Tools: The 1500 tools of various kinds that are made by the Goodell-Pratt Company, Greenfield, Mass., are described and illustrated in a Tool Handbook that has been issued by this firm. Copy free upon request.

Greaves-Klusman Lathes: A book containing complete descriptions of the latest types of lathes made by this firm has been issued by the Greaves-Klusman Tool Co., Oakley, Cincinnati, Ohio.

Air Is Your Best Helper: Air will operate your presses, chucks, vise jaws, and other tools more efficiently and at less cost. Catalog MS-11, issued by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., will show you how it is done. Ask for a copy.

Drilling and Grinding Electrically: Catalog M, showing and describing a variety of modern electric portable drills, grinders, and other tools, including floor grinders and buffers, has been issued by The Hisey-Wolf Machine Co., Colerain and Marshall Sts., Cincinnati, Ohio.

"Quick-As-Wink" Buffing Wheels that eliminate all disadvantages of rag-buffs, speed output, do better work, and cut buffing costs to the minimum are described in a bulletin that is issued free by C. B. Hunt & Son, 639 McKinley Ave., Salem, Ohio.

Assembling with Electricity: Light, portable electric tools for drilling, tapping holes, and for driving screws are described in a booklet which can be had without cost by addressing the Independent Pneumatic Tool Co., 236 South Jefferson Street, Chicago, Ill.

Special Mil-Waukee-Mills of Standard Units: A milling machine of which the base, heads, columns, and other parts are built in standard units, thus enabling the user to order a machine that will be especially adapted for his job, is described and illustrated in Catalog No. 36, issued by the Kearney & Trecker Corporation, Milwaukee, Wis. Free to machine shop executives.

Standardized Jigs and Fixtures: Information concerning standardized jigs and fixtures, also all kinds of special equipment for production, can be had by writing to H. R. Krueger & Co., 439 East Fort St., Detroit, Mich.

Cutter and Tool Grinding: A book that tells how to grind tools and cutters accurately and which also describes and illustrates the different types of LeBlond Universal Tool Room Grinders will be sent free upon request. Address, The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

Lehmann Lathes: Details of the outstanding features of Lehmann Lathes are given in a catalog published by the Lehmann Machine Co., 3560 Chouteau Ave., St. Louis.

Air-Operated Work-Holding Devices: A booklet showing how air-operated chucks and devices of various kinds can be applied to different kinds of machines to save time and labor has been issued by The Logansport Machine Co., Logansport, Ind.

Rapid-Reading Micrometer: A new type of rapid-reading micrometer, designed to show the reading in numerals, is described in Catalog No. 5, issued by The Lufkin Rule Co., Saginaw, Michigan. The catalog also contains descriptions of the micrometers, calipers, gauges, scales, squares, bevel protractors, and other tools made by this company. Free upon request.

Time Saving Machine Equipment: How machining time can be reduced to the minimum by the use of Wizard chucks, collets and tap holders, turret tool posts, self-centering steadyrests, and other McCrosky equipment is told in a book that is issued by the McCrosky Tool Corporation, Meadville, Penna. Will be sent without charge.

Lamp Guards: The various types and kinds of lamp guards made by the McGill Manufacturing Co., Valparaiso, Ind., for factory use are described in a catalog that will be sent free upon request.

Accuracy in Internal Grinding: The latest methods of producing accurately-ground holes are described in a booklet which also describes and illustrates the internal grinders made by the Micro Machine Co., Bettendorf, Iowa. Sent free upon request.

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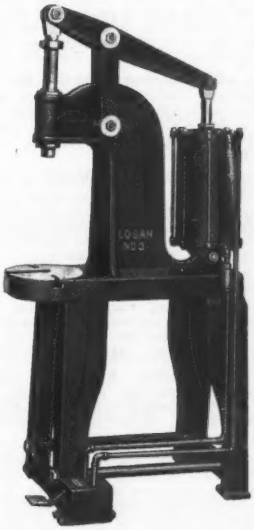

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"The 'Hole' Story in One Word" is the title of a publication that has been issued by The National Automatic Tool Co., Richmond, Ind. The book gives details as to construction and uses of "Natco" multiple drilling and tapping machines.

"How To Properly Grind Broaches" is the title of an instructive chart which will be sent free to users of broaches. Address The National Broach Company, 5 N. June St., Dayton, Ohio.

Milling Internal Keyways: A simple method of milling keyways in gears, wheel hubs, and other similar parts with the aid of a drill press and a special tool is explained in a booklet that is published by the National Machine Tool Co., 2271 Spring Grove Ave., Cincinnati, Ohio.

Save Time with Expanding Mandrels: How expanding mandrels will solve the problem of turning pieces with odd-size holes, and will increase production on duplicate work, is told in a folder that will be sent free upon request by W. H. Nicholson & Son, 136 Oregon St., Wilkes-Barre, Pa.

Ball and Roller Bearing Data Sheets: A complete set of data sheets showing all the dimensions and loads at given speeds, and giving instructions for mounting precision ball bearing and Hoffmann roller bearings, can be obtained without charge by addressing the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

Grinding Wheel Information: A booklet which tells how grinding wheels are made and graded, and which give instructions for mounting wheels, operating speeds for different kinds of work, instructions for truing and dressing, and other information has been issued by the Norton Company, Worcester, Mass. Sent free upon request.

Correct Cutter Grinding: How cutter costs can be reduced and more production per grind of cutter obtained is told in Booklet "E," published by The Oesterlein Machine Co., 3319 Colerain Ave., Cincinnati, Ohio. Sent free upon request.

"Ohio" Shapers and Planers: The latest types of shapers and planers manufactured by The Ohio Machine Tool Co., Kenton, Ohio, are described and illustrated in a series of bulletins that have been issued by this firm. All the latest features of these machines, such as automatic lubrication, instantaneous feed, centralized control, and gear box, are described in detail. Free upon request.

Self-Tapping Sheet Metal Screws: Screws which are threaded and hardened in such a manner as to enable them to cut their own threads as they are screwed into sheet metal assemblies are described in a folder which is published by the Parker-Kalon Corporation, 192-196 Varick St,. New York City., N. Y. Sent free upon request.

Making Blue Prints: Methods and equipment for producing blue prints at a minimum cost in all sizes of plants, from the small shops to the largest production plants, are described in Catalog M-55, issued by The C. F. Pease Company, 855 North Franklin St., Chicago, Ill.

Tapping Devices, Quick-Change Chucks, Stud-Setting Tools and Bench Tappers: A catalog describing the various types and kinds of tapping, drilling, and stud-setting devices manufactured by the Procunier Safety Chuck Company, 12 South Clinton Street, Chicago, Ill., can be obtained without charge by addressing this company. The catalog also tells the part that Procunier tools play in obtaining greater accuracy and less tap breakage.

Engine, Turret, and Gap Lathes are described in a series of bulletins that have been issued by The Rahn-Larmon Co., 2935 Spring Grove Ave., Cincinnati, Ohio.

Pulmore Industrial Clutch: A multiple disc clutch, made in two types, to run in oil or dry, and which is so built that it can be operated at high speeds, is illustrated and described in a folder that will be sent free by the Rockford Drilling Machine Company, Rockford, Ill.

Complete Pump Information: The Geo. D. Roper Corporation, Rockford, Ill., has compiled a catalog which is arranged so that the prospective user of a pump can immediately determine the size and model of pump that is best suited to his need. Copy free upon request.

Automatic Lubrication: Individually motor-driven pumps that keep the work flooded with lubricant are described in a booklet that has been published by the Ruthman Machinery Co., Front and Pike Sts., Cincinnati, Ohio.

Safety Grinding Wheels: The complete line of grinding wheels made by the Safety Grinding Wheel & Machine Co., Springfield, Ohio, is described in Catalog No. 11, which is issued by this firm. The book also contains instructions for operating grinding wheels, tables of grinding wheel speeds, pulley calculations, and other information for the user of grinding wheels.

Saving Time With Small Tools: A line of time-saving small tools, including "Use-'Em-Up" drill sleeve, "Wear-ever" chucks, collets, cutters, reamers and tap holders, counterbores, spotfacers, and other tools is described in Catalog 36, issued by Scully-Jones & Co., 1909 S. Rockwell St., Chicago, Ill.

Equipment For the Shop: Vises for the bench, drill press, milling machine or shaper; angle plates; adjustable clamps, jacks and other tools for the machine shop, are described and illustrated in a booklet that is published by the Sheldon Machine Co., 3253-55 Cottage Grove Ave., Chicago, Il. Copy free upon request.

"Monotrol" Geared Head Lathes: A new type of lathe, especially designed for precision work at high speeds, is described in a folder that has been issued by The Sidney Machine Tool Co., Dept. M8, Sidney, Ohio. Copy free on request.

"Chucks and Their Uses" is the name of a book which contains a full description of the different kinds of chucks and suggestions for the proper care of chucks, and tells how chucks should be fitted to lathes. It also contains a number of suggestions for general shop practice. Sent free upon application by The Skinner Chuck Co., New Britain, Conn.

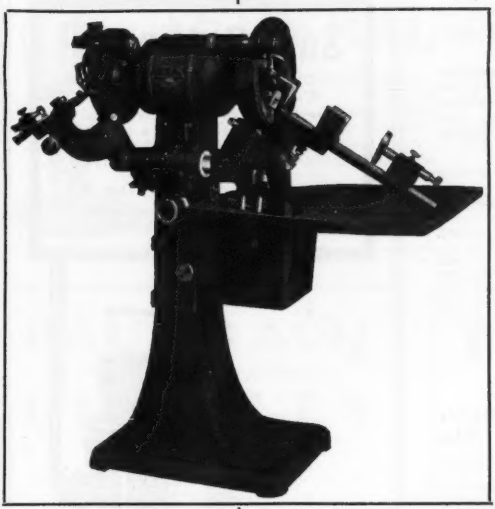
Shaping with Modern Equipment: The Smith & Mills Company, 2889-91 Spring Grove Avenue, Cincinnati, Ohio, has issued a booklet which describes and illustrates the line of modern shaping equipment made by this firm. Copy free upon request.

Electric Drilling and Grinding Equipment: A book that is issued by The Standard Electric Tool Co., 1938 West Eighth St., Cincinnati, Ohio, tells how time can be saved, better work done, and the efficiency of the shop improved by the use of electrically-driven drilling and grinding equipment. Free upon request.

Engineering and Manufacturing Service: A complete engineering and manufacturing service for manufacturers who are not equipped to handle all of their own designing, experimental, or production work is described, with illustrations of the equipment available, in a bulletin that is issued by The Steel Products Engineering Co., Springfield, Ohio.

Rigidmilling Principles and Practice: A book that shows how the Rigidmil can be adapted to various kinds of usual and unusual milling operations, and which describes in detail the work that can be handled by this machine has been issued by the Sundstrand Machine Tool Co., Rockford, Ill. Copy free upon request.

Save Cutting Oil: How cutting oil can be separated from chips and thus reclaimed by the use of a centrifugal chip "wringer," is told in a bulletin that is issued free by the Tolhurst Machine Works, Troy, N. Y.



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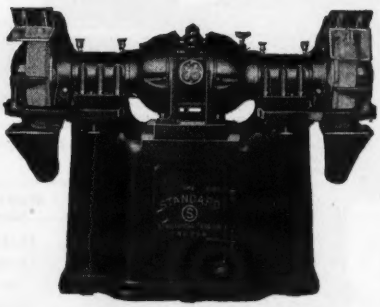

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A Simplified and Improved Drive Control for Machinery: Two distinct types of plate clutches that have proved successful highly in the driving mechanism of machine tools are described and illustrated in a bulletin that will be sent free by the Twin Disc Clutch Company, Racine, Wis.

Multiple Drilling With a Single-Spindle Drill: Methods by which multiple drilling may be done on a single-spindle drill, using multiple spindle drill heads, are discussed in a bulletin that is issued by The United States Drill Head Co., 1954 Riverside Drive, Cincinnati.

Electrically-Driven Portable Tools: The "U. S." line of electric drills, die grinders, electric screw drivers, surface grinders, tool post grinders, and bench and floor grinders is described in Catalog No. 24, which has been published by The United States Electrical Tool Co., 2471 W. Sixth St., Cincinnati, Ohio.

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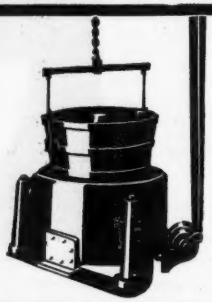

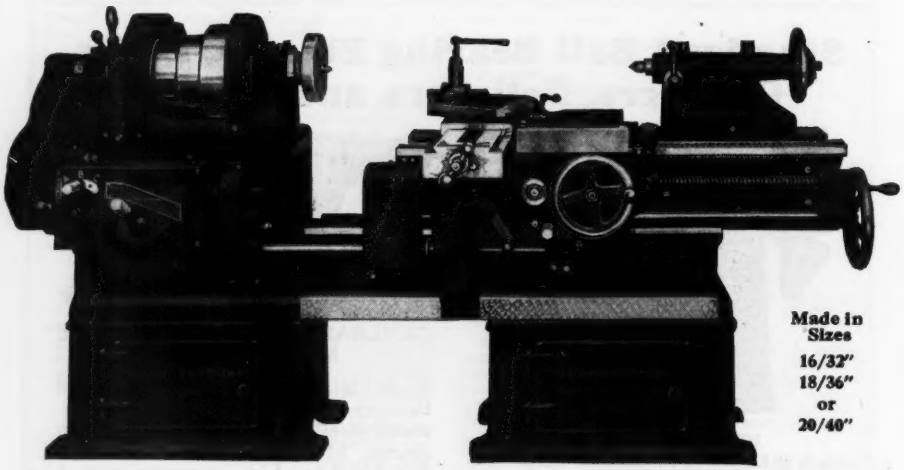

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16/32"
18/36"
or
20/40"

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A lathe for large or small swing work, ready at all times. Requires no extra rigging up. Takes different distances between centers.

Belt driven or with nine speed all geared motor driven head. Tell us what your requirements are and let us quote you.

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FEDERAL DIAL INDICATORS

Comparators
Amplifying Gauges
Thickness Gauges
Depth Gauges
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Cylinder Gauges
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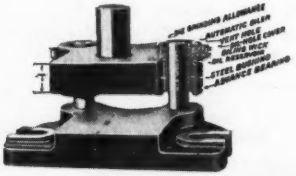
Cutter Testing Gauges
Internal and External Grinding Gauges

Federal Products Corporation, Providence, R. I.
Western Branch: 7338 WOODWARD AVE., DETROIT, MICH.

BAUMBACH
Automatically Oiled
DIE SETS



Standardized die sets, embodying many exclusive features, and a listing of 70,000 stock sizes afford a service that is unsurpassed.

Your Inquiries Solicited
Send for New 120 Page Catalog

E. A. Baumbach Mfg. Co.
1806 S. Kilbourne Ave. Chicago, Ill.

PROCUNIER

SAFETY TAPPING ATTACHMENT with the "Procunier" Safety Friction and "Double-Jaw" tap holder gives

GREATER ACCURACY and LESS TAP BREAKAGE

The Procunier Safety Friction Device is very easily adjusted. With it blind holes can be tapped just as easily as through holes, and without danger of breakage.

Catalogue 102-C gives complete details of PROCUNIER Tapping Devices, Quick Change Chucks, Stud Setting Tools and Bench Tapping Machines.

PROCUNIER SAFETY CHUCK CO.
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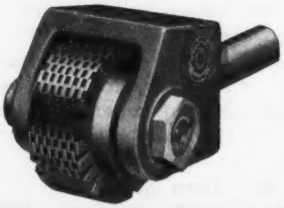


The Desmond Ball Bearing Dresser

An economical substitute for diamonds for dressing and truing grinding wheels for precision work. *Write for Catalog "M."*

The DESMOND-STEPHAN MFG. CO., URBANA, OHIO

Riff-Raff Ravings

By GEO. ALEXANDER MANN
Raver-in-Chief

Boy—Page Volstead

To make a peach cordial
Is easy, says Andy;
All that I do
Is send her some candy—

Tell Me—I Ask Yuh

When you have company come in and you go to the pantry and lift out your last half pint—Gosh—Mel—I'm askin' yuh—Ain't that "Shelf sacrifice?"

Modern Mother Goose

Ol' Mother Hubbard
Went to the cupboard,
To get daughter Tess a dress;
If you declare
The cupboard was bare,
Gosh—you oughta see Tess.

Who'll Deny Ut?

"The automobile has cut down distances"—Yeh—We're all closer to the poor house.

The new optimist is the guy who gets a cigaret lighter and throws away his matches.

Ain't Ut Sobby?

Her hub was lost at sea,
Alas—Mrs. Snooty;
They say that she lost him,
To a bathin' beauty.

A flapperette's knee may be a sight —but she'll grin and bare it.

Heard on the Phone

"Tell me, where can I
Get hold o' Miss Wickens?"
"Can't say—she's ticklish
As all o' the Dickens."

Gotta Show Speed

The difference between a man running for President in Mexico and a man running for President in this country, in Mexico he's gotta run faster.

Ain't Ut Tha Troof?

The average guy carryin' a cane don't only look weak in the legs.

Proof Enuff

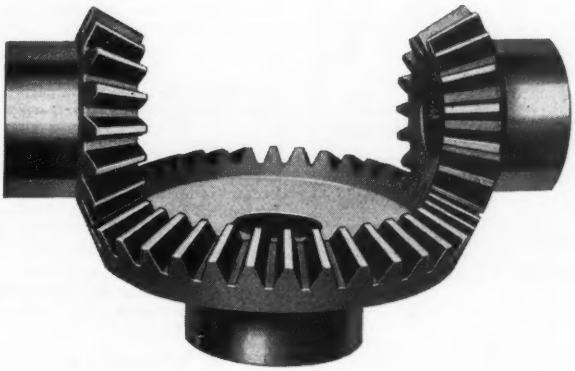
Accordin' to the Department of Commerce, the supply of nuts is adequate. If you don't believe it, look at any o' the indoor golf schools.

Hoover may be there as a food administrator, but our prediction is he's in for a helluva time when it comes to splittin' up the political pie.

An' Then Some

Declarin' war illegal won't keep women from barin' arms.

Our bevel gears are generated theoretically correct.



THE CINCINNATI GEAR CO.

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CINCINNATI, OHIO

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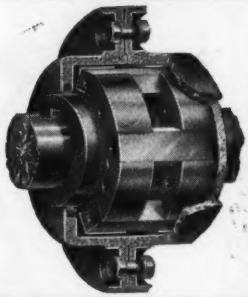


"Nicholson" Flexible Couplings

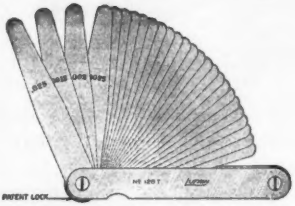
Ample compensation for practical misalignment and liberal allowance for lateral floats—a big help to an efficient drive.

Utilizing centrifugal force, with no springs or rubber to break or deteriorate, Nicholson Flexible Couplings insure quiet, efficient operation with minimum wear. *Details in Bulletin 329, may we send it?*

W. H. NICHOLSON & COMPANY
136 Oregon Street WILKES-BARRE, PA.

LUFKIN

Thickness Gages



No. 126T offers a wide range of thicknesses, and the Patented Lock Nut holds firmly in place any leaf or leaves.

Ask your tool dealer to see them
Send for Catalog No. 3

THE LUFKIN RULE CO.
SAGINAW, MICH.

TWENTIETH CENTURY BALANCING TOOL

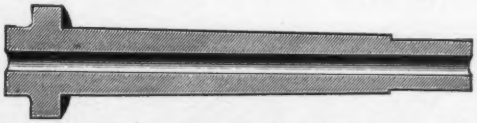
Always on the level

The most practical, sensitive and inexpensive device manufactured for balancing pulleys, cones, armatures, fly wheels, polishing wheels, etc. Will set anywhere and is easily portable. In sizes up to 24,000 pounds capacity.

Ask for the Bulletin

Sundstrand Machine Tool Co.
ROCKFORD, ILL.

Hollow Bored Forgings and Steel Shafts



You will save delay, worry and expense by placing your orders with us for spindle, piston rod, ram and clutch shaft forgings, and similar work. Quality is unvaryingly dependable, deliveries are made when promised, and prices are fair.

Let Us Quote On Your Requirements

AMERICAN HOLLOW BORING CO., 1035 W. 19th St., Erie, Penna.

Some LIGHT on HOLE PERFORMANCE of CLEVELAND TWIST DRILLS and REAMERS
Digest No. 55 on
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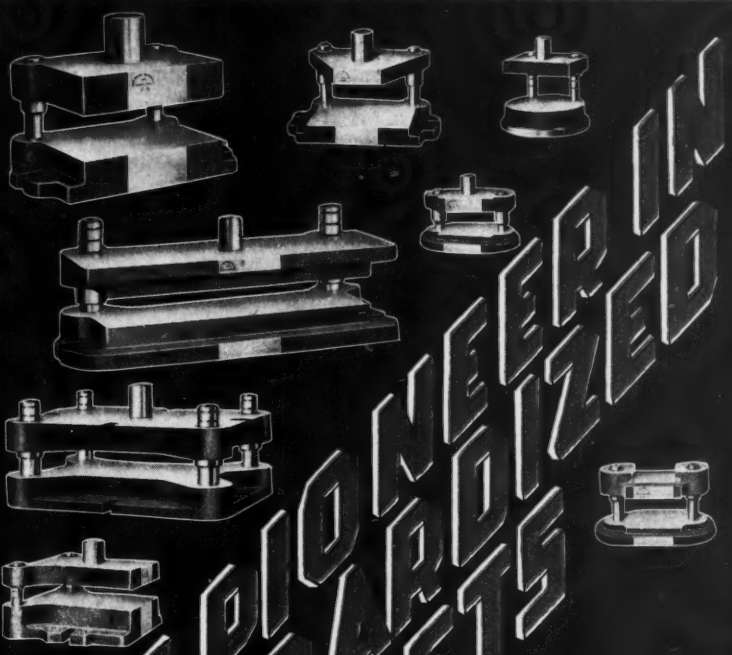
MASS production of reamed holes may be economical—or costly!

These four Digests—Nos. 53, 54, 55 and 64—tell the actual stories of effective and *economical* mass production with PEERLESS HIGH SPEED REAMERS.

We will gladly send them to you upon request, and without obligation.

The CLEVELAND TWIST DRILL COMPANY CLEVELAND



THE PIONEER IN STANDARDIZED DIE SETS

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DANLY STANDARD

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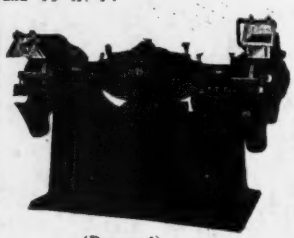
NEW RECORDS!

U. S. Heavy Duty Adjustable Speed Grinder

(4 BALL BEARINGS)

Powerful A. C. or D. C. motor of 40 degree centigrade rating, with 100 per cent momentary overload capacity. Four heavy duty SKF Ball Bearings. One-piece nickel steel spindle, etc., etc. Regular sizes 5, 7½, 10 and 15 H. P.



(Patented)

LOWER grinding costs and higher production are absolutely certain with this grinder. The chief reason for this is that it maintains a constant peripheral speed of approximately 5,500 feet per minute in spite of wheel size or wear.

Wear 24-Inch Wheels Down to 10 Inches

You can use 24-inch stones down to the flanges! Lower wheel costs and less time out for wheel changes do help. This grinder is fully up to the high U. S. standards, as indicated partially at left. Include U. S. figures in your estimates.

Ask Your Jobber or Write Us

THE UNITED STATES ELECTRICAL TOOL CO.

Oldest Builders of Electric Drills and Grinders in the World

2471 WEST SIXTH STREET CINCINNATI, OHIO, U. S. A.

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University Microfilms, Inc., Ann Arbor, Mich.